ARMY SCIENCE BOARD

AD HOC STUDY

FINAL REPORT

"Use of Technologies in Education and Training"

December 1995

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13. ABSTRACT (*Maximum 200 words*)
   This Study examines the Army's use of technology in education, here defined as the material presented by the Training and Doctrine Command (TRADOC) at the Officer Basic and Advanced Courses, the Combined Arms and Services Staff School (CAS³), and the Command and General Staff Officer Course (CGSOC).
   Currently there is a near-revolution in the means of delivering education. Video, CD-ROM's, and other devices, along with new learning techniques such as simulations and gaming, experiential learning, group learning, and structured pathing are enhancing the student's learning experience. Perhaps one of the most significant educational advances for the Army will be the use of distance learning, especially as resource constraints and Base Realignment and Closure (BRAC) activities limit conventional educational opportunities.
   The Study recommends that the Army: 1) continue to develop and acquire modern classroom technology, but emphasize a move toward distance learning; 2) commit to the use of the electronic classroom and distance learning; 3) develop appropriate outcome evaluation methods, and review the full range of education delivery systems with respect to the Army's own education needs; 4) explore existing civilian resources as alternatives to the Teletraining Network (TNET) currently in use; 5) develop the full capability of the synthesis and synergy possible with digitization, simulation, the Distributed Interactive Simulation (DIS) network, and electronic archiving; 6) develop joint research efforts with a variety of civilian institutions, and with the US Department of Education and state Departments of Education; 7) make the organizational changes necessary to implement distance learning, and institute the necessary training to effectively use and present it; 8) eliminate much of the educational role at the Branch Schools once distance learning is fully implemented; 9) consider creating the equivalent of a Board of Regents to bolster the Army's desire to move toward a "university" system; 10) move toward the notion of "shamrock" education (three types of educators) as quickly as possible; 11) continue to develop the electronic bulletin boards as a means of informal education; 12) develop a complete inventory of skills, knowledge, and abilities for each officer in order to rapidly identify experts for (continued on reverse side of page)

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teaching or operational situations; and 13) in concert with the ASB, prepare an Army Education Roadmap and request the National Academy of Sciences Board of Army Science and Technology (BAST) to critique the effort.

Adoption of this Study's recommendations will place the Army in a role as an education leader in the United States.

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DECEMBER 1995

ACKNOWLEDGEMENTS

years, and the Army is fortunate to have had a man of his acumen, talent, enthusiasm, and interest to push and protect Army interests. This Study has benefited from his guidance, and the Study participants have benefited from his friendship and wisdom.

Dr. Allen F. Grum
Study Chair

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EXECUTIVE SUMMARY

General Gordon Sullivan, then Chief of Staff of the Army (CSA), and General Frederick Franks, then Commanding General of the Training and Doctrine Command (TRADOC), requested that the Army Science Board (ASB) conduct a Study to recommend Army uses of technology in education and training. The ASB, with the concurrence of TRADOC, narrowed the scope of the Study to examine only education. The Panel arbitrarily defined "education" as the material TRADOC presents at the Officer Basic and Advanced Courses, the Combined Arms and Services Staff School (CAS³), and the Command and General Staff Officer Course (CGSOC).

The Panel visited a large number of the Branch Schools, TRADOC Headquarters, and Fort Leavenworth. The Study Group also visited several Air Force activities, the Naval War College, and several civilian institutions recognized as leaders in educational technology. In addition, the Panel conducted a reasonably wide literature search.

TRADOC has extensive programs which are developing educational technology within the Army School System; yet there is significantly more activity in the civilian education sector. Therefore, this Study should be considered as only a sampling of the many uses of educational technology. As with any sample, the data may not accurately reflect all possibilities. However, the Panel's sense is that within the education community as a whole, there is a near-revolution in the means of delivering education. Within the classroom, electronic and mechanical devices such as video disks, CD-ROM's, projection cameras, and response pads present instructors with options which were unheard of even as late as the 1980's. Distance learning gives the Army the ability to take the schoolhouse to the student at any place, at any time.

There is an equivalent revolution on the receiving end of learning. Paradigms such as group learning, pioneered by the Army Research Institute (ARI), structured pathing, the use of simulations and gaming, and experiential learning all have the capability to provide an enhanced learning experience. That is, the student may learn the same material more quickly, learn more material in a set time, retain material longer, or develop a more positive attitude toward the material.

These are not two disjointed revolutions. Educators must skillfully blend the two together to achieve the promise that each offers.

The ASB believes that resource constraints and Base Realignment and Closure (BRAC) activities will force the Army to largely depend on distance learning. Presently, the Army uses distance learning to a limited extent, which, in general, has been well received. In addition, the widespread use of electronic bulletin boards presents the opportunity for informal "education" and information exchange among cohort groups.

Particular Army strong points that will be useful in future education are the move toward digitization, the Distributive Interactive Simulation (DIS) network, and the expertise in simulation. Merging of these three will give the Army a unique capability to capture, archive, and re-create operations throughout the world for analysis and review.

The ASB was asked to identify obstacles to the use of educational technology. It appears there will be few, if any, technical obstacles in the future. Indeed, the technology will come without any overt Army action. The obstacles that do exist within the Army are cultural and organizational. The Army will need to ensure that all officers are computer literate, and will need to make certain organizational changes in order to optimize the use of distance learning.

The Study recommendations are:

1.   Continue to develop and acquire modern classroom technology, but emphasize a move toward distance learning. A notional time table for this effort is shown below:

1995   2002

"HIGH TECH CLASSROOMS"

DISTANCE LEARNING

This illustration conveys the sense that the Army now utilizes some distance learning, with a preponderance of modern classrooms. By 2002, the Panel recommends that the Army move to a small proportion of modern classrooms, with a much greater use of distance learning. It further recommends the use of distance learning for the Basic and Advanced Courses and CGSOC. Distance learning will supplement the education which will be provided at the unit level for the officer's Basic and Advanced Courses. CGSOC "clusters" will use distance learning as a primary mode. All of the education will emphasize group learning.

2.   Make the commitment to move to the electronic classroom and distance learning. This includes committing to:

a.   Continuity of leadership.

b.   Training the professional staff at the various Schools so that they are comfortable with the new technologies, and can effectively incorporate educational technology in rethinking the objectives of education.

c. The identification and recognition of a cadre of teaching professionals who will champion the approach throughout the School System.

3. Coupled with the technology's introduction must be the realization that the Army will have to develop appropriate outcome evaluation methods. In addition, the Army must seriously review the full range of education delivery systems and evaluate these systems in light of its educational needs.

4. While the Army could use the Teletraining Network (TNET) as the basis of distance learning, the Panel recommends that existing civilian resources be explored as alternatives. Local cable companies have provided cable at many installations which could possibly be used for land-based transmissions. Sharing the facilities of organizations such as the National Technical University (NTU) may be possible for satellite transmission.

5. Develop the full capability of the synthesis and synergy possible with digitization, simulation, DIS, and electronic archiving.

6. Develop joint research and study efforts with a variety of civilian institutions, such as NTU and the Institute for Academic Technology (IAT), and with the United States Department of Education as well as state Departments of Education. Take the lead as the education champion for joint programs with appropriate organizations within the other Services and the Department of Defense (DoD). Much of the hardware research and development, such as increase in bandwidth, will come without the need for Army funds. However, the propagation of the new learning paradigms, particularly within the entire Army (Reserve Officer Training Corps [ROTC] programs, for example), needs Army funding support.

7. Make the organizational changes necessary to implement distance learning, and institute the necessary training to effectively use and present it. The Panel's preference is to establish Fort Leavenworth and Fort Lee as "managers" of education. In other words, their responsibilities would include such activities as developing qualification tests, identifying distance learning instructors, arranging satellite time, etc. This would parallel the national education philosophy of decentralized education with national standards.

8. Eliminate much of the educational role at the Branch Schools once distance learning is fully implemented. In the interim, conduct careful tests to determine the appropriate level of Branch School participation in either the managing or presentation of Branch-specific education.

9. Although Panel members do not unanimously support this recommendation, there is some sentiment that the Army should create a Board of Regents or similarly named group to bolster the Army's desire to move toward a "university" system. In addition, the Army should consider creating a provost position at appropriate institutions within the university. If the recommendation to establish Fort

Leavenworth and Fort Lee as the managers of education were to be adopted, it would be logical to have a provost at each of these locations. The Army would walk the fine line between ossification and instability by following a procedure such as that used with the Dean of the Academic Board at West Point. An officer or civilian would be appointed provost for a five-year period, subject to review and either termination or renewal at the end of the period.

10. Move toward the notion of "shamrock" education (i.e., three types of educators) as quickly as possible. Identify core topics which *absolutely* require active-duty instructors, topics suitable for contractors, and topics suitable for irregular workers. The Army can well civilianize a great portion of its education program. In particular, many retirees have far richer experience in combat, logistics, intelligence, and other Army activities than will exist within the active field-grade cadre of the near future. This suggests the core topics may be quite limited.

11. Continue to develop the electronic bulletin boards as a means of informal education. Require all officers to be computer-literate as certified by appropriate testing; to either own or be provided a computer; and to be connected to the Internet. Explore the emerging World Wide Web as an alternative, in order to be more than a bulletin board but less than the two-way audio, two-way video available through TNET.

12. Develop a complete inventory of skills, knowledge, and abilities for each officer in order to rapidly identify experts for teaching or operational situations.

13. In concert with the ASB, prepare an Army Future Education Roadmap and request the National Academy of Sciences Board of Army Science and Technology (BAST) to critique the effort upon completion.

The ASB strongly feels that adoption of this Study's recommendations will place the Army in a role as an education leader in the United States. This is a rightful position for the Army. Acceptance of a lesser role should not be acceptable.

I. INTRODUCTION

A. BACKGROUND

General Frederick Franks, then Commanding General, Training and Doctrine Command (TRADOC), and General Gordon Sullivan, then Chief of Staff of the Army (CSA), initiated this Study. The Study is a natural outgrowth of General Sullivan's Force XXI philosophy that, "We will achieve this quantum improvement in effectiveness through the power of information, through knowledge based warfare." (See Appendix 1 in the Supplement for the complete Force XXI statement.) The Study also reflects the CSA's concern that the Army needs to "...create pools of skilled leaders that we can draw on to accomplish these missions without unacceptably degrading other units," and his conviction that:

> *Today's world and the world of the near future will continue to be this kind of complex and difficult world. Our nation will call on us to serve in many ways. Our purpose, to fight and win our nations wars, our vision of selfless service, and our uncompromising quest for quality make us the world leader.... America's Army.* (See Appendix 2 in the Supplement for the trip report of GEN Sullivan to Europe and Africa on 9-15 August 1994.)

The Army has enjoyed an enviable system of officer education. Neither General Sullivan's nor General Franks' interest in pursuing this Study is directed at present inherent weaknesses in this system. Their interest is in identifying possible future needs. The initiators of this Study recognize that rapid change in an information age is a discontinuity, not an evolution. Experts estimate the half-life of information is now only 18 months, and by the year 2000 the amount of available information will have doubled 19 times. Army officers and the Army's education system are neither isolated from nor immune to this phenomena. This reality, together with the reduction of the Army's force to 495,000 soldiers--the lowest end-strength since before World War II--and Base Realignment and Closure (BRAC) efforts all call for an examination of the Army's use of technology within its education system.

An expected lesser amount of resources in both dollars and manpower in no way lessens the need for continuing professional education. In fact, continuing education is now more important than ever. In today's world of rapidly evolving technologies and processes, military professionals, like professionals in every sector, must constantly hone and upgrade their knowledge and skills. To maintain professional competence, remain flexible, and be part of an effective team in any situation, an individual has the burden of learning new processes and technologies, thinking critically, and reacting appropriately in every context.

New educational modalities exist that may support this need for life-long continuing education. However, the modalities must be used with caution to ensure they create a learning process that is linked to the goals of education.

Army simulation models such as Janus offer prototypes for understanding the linking of technology with learning. Janus allows the rapid determination of battle outcomes, the ability to replay a battle, and a comparison of many courses of action. In turn, this learning process presents an opportunity for group learning, the utilization of individual pathways to knowledge, creative thinking, and experiential leaning. It would appear to be an effective use of educational technology.

The Panel has been unable to identify uniform and statistically significant evaluations of many of the Army's initial uses of educational technology. Educational technology is not a panacea for either teachers or students. Faculties must clearly articulate appropriate goals, and knowing when, where, and how to apply new educational tools is an art in itself. Appropriate and effective application of these tools requires the educator to think about how the tool itself may affect the learning process and, in light of its impact, reshape the course, the curriculum, and the teaching process. Too often, educators simply apply technology to existing courses without realizing that the interaction of technology and curriculum results in new courses, not rehashed old ones.

In short, there are ongoing revolutions in the means by which education is both "sent" and "received." The Army must embrace both revolutions to achieve effective results.

B. TERMS OF REFERENCE

The CSA's and TRADOC's interest resulted in an original Terms of Reference (TOR) (see Appendix A). The Army Science Board (ASB) Study Panel examined the TOR after meeting with TRADOC officials, and suggested that the Study focus on the use of technology in Army education. This focus was approved by the Study Sponsor, GEN Franks (see Appendix B). The Panel defined "education" as:

> Education: The courses TRADOC offers to officers at the Basic and Advanced Courses, Combined Arms and Services Staff School (CAS³), and Command and General Staff Officer Course (CGSOC).

The Study Panel emphasized this focus on education in a subsequent letter to Mr. Hollis, following a meeting with General Sullivan (see Appendix C).

After the Study was well underway, the CSA indicated that he was particularly interested in a Study of "leader development," with a lesser focus on the use of educational technology to assist in leader development. As indicated in Appendix B, TRADOC had a strong interest in the use of technology for training. Therefore, the ASB elected to terminate the present Study at a point which may not appear to fulfill all of the requirements of the original TOR. However, the Study has merit in its own right, and will also serve as a valuable data base to support any follow-on studies which focus on leader development and the use of technology for training.

From the beginning, this Panel recognized that the means of delivery and the objectives of education are inextricably intertwined--as one Panel member stated, "The Army wants to use

educational technology; to what end?" This fact became more evident as the Study progressed; however, limited resources prevented a careful examination of the objectives of education. New technology may well bring a need for new objectives and a discarding of old ones. Future studies should recognize this possibility.

C. A BASIC DEFINITION

The Study's TOR asked the ASB to identify technologies and techniques to enhance education. There are numerous rubrics used in the education community to describe these technologies, such as "computer-based instruction," "academic technology," "instructional technology," "educational technology," "multi-media presentations," and perhaps several others. The Panel chose the term "educational technology," to connote as wide a meaning as possible.

> Educational Technology (also called learning technologies): All electronically and mechanically assisted education, distance learning, simulations, gaming, new instructional methods and devices (software and hardware), and collaborative learning.

In short, the Panel includes anything that brings technological tools from science, engineering, psychology, or pedagogy to bear in delivering education to Army officers.

D. STUDY LAYOUT

This Study reviews the use of educational technology within the Army, Air Force, Navy, and other Department of Defense (DoD) activities in Section II. It looks at the use of educational technology in the civilian sector in Section III. Material on new learning paradigms that are brought about by the use of technology is presented in Section IV. The Study Group's efforts to foresee the hardware and software of the future are presented in Section V. Organizational constructs are discussed in Section VI. A number of obstacles to the use of educational technology are identified in Section VII. The Panel presents its findings in Section VIII, and its recommendations in Section IX. An extensive amount of background material buttresses the main Report; it is available in a Report Supplement from the ASB Secretariat. In addition, a large collection of files is available for use in future studies.

II. DoD EDUCATIONAL TECHNOLOGY EFFORTS

A. ARMY

1. INTRODUCTION

Leader development and education are the means by which the Army will achieve Force XXI. The key to taking Army education into the 21st Century is to have the capability to provide unrestricted access to knowledge, data, expertise, simulations, real-time operational missions, and other educational resources at any time and from any location around the world. As a result, the Army officer becomes a student-leader-teacher for all of his/her career.

The ASB Study Panel examined the Army's utilization of educational technology by receiving briefings from the organizations listed below. The Panel acknowledges in advance the possibility of omissions and misunderstandings in this process, and of forming conclusions that are filtered through its members' own biases. The Panel hopes that the Army does not react defensively to this Study; if it does, the Panel has failed in its attempt to paint the "big picture." For indeed, there are many bright spots in both the Army and civilian education communities. Rather than spend time posturing about the past, the Panel hopes that the Army will resolve to turn its energies to the exciting, but enormous, task of preparing for the future.

The activities visited include:

> TRADOC Headquarters
> Fort Eustis
> Fort Leavenworth
> Fort Sill
> Fort Huachuca
> Fort Leonard Wood
> Fort Gordon
> Fort Knox
> Fort Benning
> United States Military Academy

2. THE TRADOC VISION

TRADOC intends to establish a "World Class" university system of schools and training centers which will graduate leaders capable of winning the Nation's wars--the Land Warfare University. This university will incorporate the latest in educational technology and learning strategies, so that the required research and educational opportunities are available regardless of the time of day or the location of either the student-leader or the source of the necessary information.

TRADOC has begun to implement the vision by linking Active Components, Reserve Components, and Army National Guard units into congruent training. A pilot effort is currently underway with Region C in the southeastern United States. In addition, Classroom XXI and the Classroom Without Walls support the vision, as educational technology will improve the quality of classroom education, as well as provide education beyond the classroom. Taking the classroom to the student rather than bringing the student to the classroom will result in a university that never closes.

TRADOC has established a Research and Development Plan to support this vision, and has completed several experiments which looked at the utility of educational media, such as video teletraining and teleconferencing. In addition, the Army has maintained distance learning facilities for several years. In 1993, TRADOC merged two existing satellite networks--the Satellite Education Network and the Teletraining Network--to form the Army's Teletraining Network (TNET), a network devoted solely to education and training. Since that time, TRADOC has expanded the network by establishing links with several states, the Department of Housing and Urban Development, the Navy's training net, and the United States Air Force Reserves.

The Army has been the leader in developing simulations and an integration capability through Distributed Interactive Simulation (DIS), which allows two or more geographically dispersed units to train together. The move to digitization will also enhance TRADOC's ability to deliver education to the officer.

3. FORT EUSTIS

The Transportation School at Fort Eustis is one site that has developed a prototype classroom of the future. This classroom is a traditional "desk-in-rows" layout with an extensive "hard-wired" computer system. The desk-in-lines concept was apparently dictated by the Architect-Engineer, in spite of the recognition that: (1) it is not the optimal layout for using educational technology; and (2) it is not flexible enough for the small-group instruction that TRADOC emphasizes.

Fort Eustis maintains an electronic bulletin board system that provides access to a CD-ROM multimedia system for officers external to Fort Eustis. The Transportation School offers six courses through this medium. The Panel was led to believe that the School maintains an additional electronic bulletin board, similar to those found on the Internet, to exchange information with Facility Transportation Officers. The Panel believes that this bulletin board is on an Army network that is separate from what is generically described as the "Internet."

The Panel was impressed that Fort Eustis had conducted one of the most careful Army assessments of distance learning outcomes that this Study Group encountered. The basic conclusion: students at remote sites did as well as those in the classroom.

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4. FORT LEAVENWORTH

Fort Leavenworth is an example of resource-limited educational technology. At the present time, each student section (16 students) has access to only one 286 computer and printer in the classroom. Some students use other computer assets at the National Simulation Center and the TRADOC Analysis Center.

Some evidence of technology upgrading is apparent, as: (1) computers with Pentium capability are slated for the classrooms; (2) a TNET node will become active in the spring of 1995; and (3) the courses will use existing simulations such as Janus more heavily.

The Panel did see two promising uses of technology at Fort Leavenworth. One is a massive project to electronically archive what amounts to the entire research and library holdings of the School. The second is the production of a CD-ROM version of Field Manual (FM) 100-5. The CD-ROM will eventually include the usual menu of enhancements, such as use of color, voice-over, hyper-text, and illustrations. This multimedia presentation will hopefully increase the educational value of what has been a traditional, printed-page FM. Both of these efforts deserve Army support, and will be useful in offering education to officers in the future.

There is a personnel problem at Fort Leavenworth which affects the introduction of educational technology into the curriculum. The position of Deputy Commanding General, in essence the Chief Academic Officer of the School, has turned over four times in five years. Often, the introduction of educational technology into a program is the result of the efforts of a strong leader. Lack of leadership continuity may make it difficult to develop the willingness to change traditional routines and bring effective educational technology into a program.

5. FORT SILL

Fort Sill is one of the Army's leaders in distance education. The School uses a wide range of technology, which includes instruction-interactive video, computer-assisted instruction, video teletraining, and cohort groups. An Army evaluation indicates that the students in the remote sites do at least as well as those physically located at Fort Sill.

6. FORT LEONARD WOOD

Sixty-five percent of the officers who attend Fort Leonard Wood have a science or engineering degree. The Engineer School recently completed an agreement with the University of Missouri at Rolla (UMR) to award a Master's Degree in Engineering Management to officers who attend the Officer Advanced Course and who complete 16 weeks of additional full-time study with UMR. A separate ASB Panel will comment on the desirability of this arrangement. The Panel realizes that propinquity and tradition may have played a large role in the selection of UMR and the conscious decision to elect classroom-based education. However, the Panel is uncertain whether the Engineer School

was sufficiently cognizant of distance learning opportunities in other civilian educational institutions, or whether these were given sufficient consideration.

7. FORT GORDON

It might be expected that the Signal School is at the frontier in the use of educational technology. At one time this may have been true. Resource constraints have actually caused the School to retreat from the use of technology in previous years. The Army should carefully heed the lessons learned at Fort Gordon, some examples of which follow.

The School began a program to develop Interactive Video Disks (IVDs) in 1985. Unfortunately, each IVD took 18 months to complete, and the program was cancelled in 1991. The IVD developers had no formal training, and were required to learn on the job. Reductions-in-force (RIFs) and transfers resulted in turnover of the IVD experts. Developers were assigned to higher-priority jobs. Finally, software problems such as incompatibility, inflexibility, and difficulty of use caused School officials to question the merit of the IVDs.

The School also initiated a computer-based training (CBT) program in 1989, which was designed to be used within Fort Gordon. A shortage of funds and personnel caused the School to dissolve the program in 1992. In the interim, the School perceived that CBT required high-quality electronic equipment, personnel with experience designing CBT instruction, and extensive training for everyone involved in the presentation of CBT.

Fort Gordon used the satellite instruction available from the Army Logistics Management College (ALMC) through the Satellite Education Network (SEN). One course alone saved approximately $27,000 in per diem and travel costs. However, the School had difficulty finding and training the facilitators needed for the course. Some equipment failed, and classroom location assignments were "catch-as-catch-can." The School had some difficulty arranging the presentation of the desired classes with ALMC. On the positive side, student responses to the courses were favorable.

One of the highlights of the Panel's visits was the use of the TNET by the 513th Military Intelligence Brigade at Fort Gordon, for language courses presented by the Defense Language Institute (DLI) at Monterey, California. Maintaining a language proficiency is critical for the personnel of the 513th, yet many of the required languages are not available through local schools or translators. Consequently, the 513th and DLI have developed an eminently successful distance learning operation. It is a prototype for further distance learning opportunities.

The Panel found that, despite some bright spots such as the example of the 513th, the trip to Fort Gordon revealed many of the difficulties the Army will face as it attempts to incorporate educational technology into its School System. Lack of resources, management problems, command turnovers, changing priorities, a seemingly large number of prescriptions and proscriptions from higher headquarters, the need to follow set

procedures, and some lack of imagination in attacking problems do not augur well for the introduction and implementation of a successful educational technology program. A strong lesson learned is that local *untrained* instructors, no matter how well intentioned, will not be able to develop effective educational material.

8. FORT KNOX

Fort Knox has a reputation within the higher echelons of the Army as being a leader in the use of educational technology. There is a great deal of activity there, but the Panel's impression is that the School's main thrust is to attempt to upgrade equipment within the classroom. One visitor characterized the School's attitude as "... intending to preserve the schoolhouse." While Fort Knox was monitoring some distance learning efforts, there did not seem to be much real interest in the topic. It must be admitted that the Panel's visit to Fort Knox occurred late in the Study, which may have affected its members' opinions regarding the installation's efforts to provide effective technology within the classroom.

9. FORT BENNING

Fort Benning was a surprise of a different sort. The Infantry School could be expected to be the most conservative, hide-bound School in the Army's education system. The Panel was pleased to learn that the School has active plans for distance learning, using fiber optics rather than satellite. The Infantry School has a training net already established with the Iowa National Guard; the 116th Armored Cavalry Regiment (ACR) at Boise, Idaho; and the 48th Mechanized Brigade, a unit scattered throughout Georgia. There is an active program to export several of the courses, and an openness which the Panel members found particularly impressive.

10. UNITED STATES MILITARY ACADEMY

In 1993, the Military Academy established an Advanced Technology Classroom Laboratory, which resulted from a gift from the West Point Class of 1954, augmented with appropriated funds. The classroom has an impressive array of hardware, but the Academy emphasizes that it is indeed a *laboratory*. The initial uses of the classroom have achieved mixed results. The Academy is now putting together the necessary complement of subject-matter experts, technology experts, and educational psychologists in order to fully understand how learning may be improved through the careful use of technology. The Army should emulate this approach across the board. Simply placing an instructor in a classroom filled with a large menu of electronic devices will improve neither teaching nor learning. In addition, the Academy classroom illustrates that educational technology is expensive, not only in dollars for the purchase of equipment, facilities, and software, but also in time needed by the faculty for lesson preparation. Finally, it must be remembered that funds must be provided for the upgrading of equipment, which at this time unfortunately becomes obsolete quickly. Appendix 3 in the Supplement is an analysis of the Advanced Technology Classroom Laboratory at West Point.

B. AIR FORCE

The Panel examined three Air Force uses of educational technology: (1) the Air Command and Staff College; (2) the use of an Army TNET node by Headquarters, US Air Force Reserves at Robins Air Force Base, Georgia; and (3) the United States Air Force Academy's (USAFA) "Classroom of the Future."

1. AIR COMMAND AND STAFF COLLEGE

The Panel found the use of technology by the Air Command and Staff College to be a singular highlight of DoD activities encountered in this Study. The College loaned an IBM-compatible notebook computer to each member of the 1993-1994 class. The machines had a full complement of software for common tasks such as word processing, data base manipulation, spread sheets, multimedia overhead preparation, and simulations. In essence, the computer was the backbone of the entire academic year. The computer and associated software were a unifying and integrating means which allowed group interaction, capture of lectures and presentations, and a common platform for analysis and presentations. The Air Force built on the year by providing a CD-ROM that was a summary of the year's experience to each student. (This CD-ROM is available at the Futures Office at Fort Leavenworth.)

As with many of the activities the Panel visited, there has been little formal or careful evaluation of the learning enhancement engendered by this technology. However, Panel members' observations, after talking with students and faculty members and viewing the CD-ROM, suggest this was a very successful venture. (The only negative Panel members heard was an expression that at least some of the officers would not have a computer, or at least a compatible computer, at their next station.) Appendix 4 in the Supplement contains additional details.

2. THE WARNER ROBINS AIR BASE ARMY TNET NODE

Panel members visited the Air Force Reserve Headquarters on 22 September 1994, as it uses the Army's TNET to present education, training and teleconferencing throughout the United States. (As an aside, the Study Group found it puzzling that the Air Force should have several Army TNET nodes, while logical Army installations such as Fort Leavenworth and West Point do not enjoy these resources.) The Panel spent two hours in a conference with a talented young Air Force Sergeant: although physically he was in the next room, some ten feet away from Panel members, the conferees used the Army TNET capability to talk via satellite. The TNET is two-way audio/video. Appendix 5 in the Supplement contains additional details.

> Perhaps more than any other single experience, this demonstration was compelling evidence that distance learning, using modern technology, was not only possible but resulted in very little, if any, lessening of learning compared with a traditional classroom setting.

The Panel was also impressed with the Army's management of the TNET program. Oklahoma State University (OSU), under contract to the Army, furnishes each TNET node with state-of-the-art equipment, maintains the equipment on-site, and manages the network. The Army concentrates on presenting the instruction. The Study Group lauds this as a worthy role model for future endeavors.

3. THE USAFA's "CLASSROOM OF THE FUTURE"

The Air Force Academy, in contrast to the Military Academy, developed an electronic classroom through a turn-key contract with IBM Federal Systems. The Academy used the classroom for the first time in Academic Year 1992-1993. The facility includes computer screens, digitized video, videotapes, laser discs, a document camera, and CD-ROM capability.

The Academy has used this classroom for a wide variety of classes. Examples include:

- English literature and writing classes used *Daedalus* software throughout the semester for networked peer editing, collaborative work, and discussion sessions which were monitored or actively joined by instructors from the instructor station.

- Economics classes used network software that simulated various economic scenarios, to test the effects of these simulations on learning.

- Freshman- and sophomore-level calculus classes used the commercial software package, *Mathematica*.

Lessons learned by the Air Force regarding educational technology are similar to many Army experiences. Students do like the electronic classroom, but instructors' preparation time is increased. The physical layout is not optimal, and features of the classroom (such as lighting) need careful attention. The evaluations during the first year were at a "fairly superficial level." More careful evaluations are being planned, to include visiting faculty members and graduate students. Appendix 6 in the Supplement contains additional details.

C. NAVY

The Panel's sole contact with the Navy was a visit to the Naval War College (NWC).

Whereas Army and Air Force officers are typically assigned to bases conveniently located near educational institutions, Navy officers spend the preponderance of their careers at sea. Navy schools must educate their officers without the aid of local institutions, in an environment where there is little or no accessibility to professors, libraries, or classroom facilities. It would therefore seem that the Navy would be a leader in using high technology for educational purposes, due to economies of space (e.g., one CD-ROM versus a stack of books) and the accessibility gained by electronic data transmission. However, a visit to NWC revealed that this is not the case. The War College tends to lag behind comparable Army and Air Force institutions, and is only beginning to explore alternatives to traditional education that can be achieved through the incorporation of high technology.

Several years ago, NWC tried to use interactive satellite learning programs, which linked learning centers to one or more teachers in other locations, but the experiment failed miserably. Poor transmissions, long delays in response times, grainy video, and the high cost of telecommunications equipment contributed to the experiment's failure. Now that technology has improved, the War College is again looking into satellite learning as a possible alternative. But to date, distance learning via satellite transmission is not being utilized.

NWC does not have a strong interest in electronic methods. The focus is on education (education is used here in the classic definition of the word, rather than the definition used by the Panel in this Report), not training, and War College faculty members are of the opinion that while technology may be suitable for technical training and tactics courses, it is not suited for education. The education of senior officers is directed at developing high-level cognitive skills, not imparting information. In light of declining budgets and limited resources, NWC is not in a position to make a major investment in high technology for education. Some technological improvements are being incorporated, such as installing a local area computer network. However, the faculty and decision makers at NWC do not appear to be advocating greater use of technology in education. Although the Navy seems less interested in using learning technologies to deliver education than the Army or Air Force, it has provided a rationale for its actions, based on educational purpose and need. The Panel did not hear such an articulation from the Army regarding classroom versus distance learning or high-tech versus traditional classrooms.

Although some courses at NWC are incorporating courseware and decision support systems, use is infrequent. The focus is on seminar-based learning, and attempts to bring technology into this system will encounter a great deal of institutional drag. The commitment is to high-quality professors and their educational mission, and the faculty is not seen as supportive of high technology in the classroom. Technology at NWC is really used to support administrative functions rather than educational missions.

Even in the war gaming course, the computer is not seen as a major contributor to learning. The computer-assisted model is viewed as useful only in logistics planning. Faculty members employ the traditional student-teacher model. The real worth of computer simulations is

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apparent at the tactical level, but at the operational level and above they are seen as providing a gross simplification of reality, or a limited set of options. The focus of learning at NWC is on the process of thinking at the strategic level; to date, available computer programs are not viewed as supportive of that educational need.

As technology improves and costs diminish, the Navy may adopt electronic media for assistance in distance learning. However, there is certainly no thrust at NWC for high technology boosts to its education program, as these tools are not viewed as supportive of the level of education or the sophistication of thought that occurs at the strategic or operational level.

D. OTHER DoD ACTIVITIES

The Panel only examined one DoD activity that was not Service-specific. This was the DoD Polygraphic Institute (DoDPI), a unique activity that offers training and education in polygraphic sciences, to include a Master of Science in Forensic Psychophysiology (catalog available in the Futures Office, Fort Leavenworth); the Panel received a report on this activity (see Appendix 7 in the Supplement). DoDPI uses an unusual amount of videotaping, both of classes and practice interrogations; both students and faculty have commented on its utility. While DoDPI has access to an electronic media conferencing center, it is rarely used. There were no other significant uses of educational technology at DoDPI.

III. CIVILIAN EDUCATIONAL TECHNOLOGY EFFORTS

A. INTRODUCTION

In the previous section, the Panel noted the large number of Army activities involved in the use of technology in education and training. The civilian sector is, if anything, even more crowded with schools that are using "technology" in education and training. Much of this use is a matter of definition, as some schools may consider a piece of equipment no further advanced than an overhead projector as a use of technology. Obviously, other schools are farther along the learning curve, using a great variety of technologies within the classroom and in distance learning. Appendix 8 in the Supplement is an extract of an EDUCOM[1] report on 101 success stories on the use of information technologies in higher education. These range from Cornell's Beef Cow Herd Simulation Program, to Delaware's Latin Skills development programs, to the Beowulf Workstation at West Virginia University. There is also a wide range of the sizes and types of academic institutions that reported success with educational technology.

B. MODERN CLASSROOM ACTIVITIES

One of the civilian institutions best known as a leader in the field is the Institute for Academic Technology (IAT), which is a joint effort between the University of North Carolina at Chapel Hill and IBM. Many Army personnel with whom the Panel met had at least a passing knowledge of IAT, and some had significant interactions with this institution.

The hardware at IAT includes a wide spectrum of VCR's, large screen TV's, computers, video cameras, document cameras, etc. IAT emphasizes the electronic network within the classroom, as the institution firmly believes that an effective electronic network is key to all modern classrooms. Another emphasis in on controllers; i.e., the hardware that allows the instructor to switch from, for example, a computer display to a document camera display. IAT feels that an instructor must have a quick and easy means of moving from one hardware device to another in order to be effective in the classroom. Adequate controllers presently cost in the neighborhood of $8000. IAT also emphasizes the systems approach. For example, a distance learning studio requires special lighting and heating, ventilation, and air conditioning to be effective. This approach may be contrasted with the classroom at Fort Eustis, which was laid out in a less-than-optimal manner by the Facility Engineer, who, in putting together a high-technology classroom, was apparently doing "business as usual."

C. ASSESSMENT

Assessment of "learning improvement" through educational technology has varied from poor (even non-existent) to very good. One of the Panel's contacts characterized many existing

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[1]EDUCOM is a consortium based in Princeton, New Jersey.

assessments as "happy" surveys (i.e., surveys that asked students and instructors whether they liked the high-technology classroom and instruction). However, there is some body of evidence that indicates that computer-aided instruction, distance learning, and computer-controlled video disk instruction is at least as effective as traditional instruction, and, in some instances, even better. For instance, in "Meta-Analytic Studies of Findings on Computer-Based Instruction," in Technology Assessment in Education and Training, edited by Baker and O'Neil, 1994, Kulik reports the following:

1. Students learn more in classes in which they receive computer-based instruction.

2. Students learn in less time with computer-based instruction.

3. Students like their classes more when they receive computer help in them.

4. The average effect of computer-based instruction in 34 studies of attitude toward subject matter was near zero. In other words, although computer-based instruction was a significant factor in enhancing outcomes in the cognitive domain, the effect of computer-based instruction on outcomes in the affective domain was small.

D. DISTANCE LEARNING

The leader in offering graduate-level engineering degrees through distance learning is the National Technical University (NTU) at Fort Collins, Colorado. This is a truly remarkable organization that has melded quality teaching and technology to offer graduate education to students who otherwise would be unable to matriculate at a traditional academic institution. The course content and professor are exactly the same as in the classroom, as the actual class is captured on video feed. Currently the presentations are one-way video, two-way audio. Students have access to the faculty either in real-time during the presentation, through the use of two-way audio, or after the class in what would amount to a professor's "office hours."

The Army should study NTU closely, as it is an organization that will likely be the model for the Army's School System of the future. The staff at Fort Collins is small—fewer than 50 people—with an annual budget of $15,000,000. Yet during the 1992-1993 academic year, this organization offered 22,702 hours of academic credit instruction and 2,980 hours of non-credit Advanced Technology and Management Programs. In addition, NTU presented more than 300 short courses during the year. Over 100,000 technical professionals and managers participated in NTU programs. All this with a staff of only 50 personnel! Appendix 9 in the Supplement contains additional details.

> **NTU manages education. Experts from all over the world provide the education.**

Air Force use of NTU is sizeable; Army and Navy use is far less. The Panel was unable to discover the cause of this disparity, although the Military Academy suggested that cost was one issue. It was noted earlier that the Engineer School recently completed an agreement with UMR to award a Master's Degree in Engineering Management to officers who attend the Advanced Course and who complete 16 weeks of additional full-time study with UMR. This is a conventional, in-the-classroom program. The Panel's evidence indicates that the Engineer School probably did not seriously consider NTU or other distance learning opportunities as viable candidates.

E. HIGH-TECHNOLOGY TEACHING

The Army must realize that high-technology teaching differs from traditional teaching. Faculty training is *sine qua non*. New Mexico State University is recognized as one of the leaders in preparing professors for technology-aided classrooms. A representative course, costing $3,800 for two days of instruction, emphasizes preparing faculty members for television teaching. A second widely recognized institution for high-technology teaching is Boise State University, which offers a Master of Science in Instructional and Performance Technology. This master's degree prepares students for careers in instructional design, job performance improvement, human resources training, and training management. These are skills that will be increasingly important to the Army as educational technology becomes more prevalent. Army personnel in either human resource management or training would be logical students for this program. Boise State puts "its money where its mouth is," as it is possible to complete the program through distance education. Finally, OSU has a long and rich history of offering distance learning for the Postal Service, as well as providing and managing the Army's TNET.

The Panel noted in the previous section that educational technology is labor intensive, as personnel at Fort Gordon have learned. The initial up-front effort in preparing a lesson for a high-technology classroom is significantly greater than preparing a traditional lecture. One faculty member suggested that it may take as many as 80 hours to prepare for a one-hour lecture. A number of factors contribute to this increased preparation time: (1) there is a rich menu of hardware; (2) it must be determined whether the instruction is suitable for computer, document camera, or old-fashioned overhead; (3) it must be decided if gaming or simulations should be used; and (4) if structured pathing is appropriate, then decisions regarding which paths should be used and how many are needed must be made. These decisions go far beyond the organization of a conventional lecture. Once an instructor has prepared a lesson, he/she may use it in subsequent presentations. Unfortunately, this removes some of the freshness and flexibility that exists with conventional instruction. In addition, the Army has a high turnover of faculty within the School System. A "canned" presentation from one faculty member may be unsuitable for his/her replacement.

One of the great benefits for an instructor is the learning he/she gains during preparation for a class. The research, analysis and synthesis, and final amalgamation of numerous sources to form a coherent whole, pitched at a level of student understanding and achieving both sharing of knowledge and creation of excitement is what education is truly about. It is unclear what will happen to this process with the advent of educational technology. If the technology itself--that is,

the use of technology--becomes a time-sink that lessens an instructor's ability to prepare for a class, then education may suffer. Similarly, education might also suffer if an instructor simply pulls a "canned" presentation off the shelf because he/she does not have the time to use the technology. The Army has rightly directed that two classes graduate from Leavenworth each year. One is the large number of students at CGSOC. The second is the group of instructors who have completed their assignment at Leavenworth and are returning to other Army assignments. Misuse of educational technology should not be allowed to degrade the education of either of these groups.

F. RESEARCH

As might be expected, the National Science Foundation (NSF) has a strong interest in educational technology, and has funded research efforts to support its use. The NSF grants have supported course and laboratory upgrades, integration of basic material with applications and practice elements, computer integration, and multimedia integration.

NTU has unofficially offered to join the Army in a number of research efforts (see Appendix E). In particular, NTU would like to jointly research the potential benefits of PC-based multimedia groupware. The Panel believes that this mutual effort would greatly leverage the Army's research effort, which the Study Group believes is underfunded.

> **The Panel strongly supports the NTU proposal.**

G. MEDICAL EDUCATION

As a "profession," the Army is not unique in demanding continuing education as a requisite for remaining in and progressing through the field. Law and medicine, among others, come to mind.

Medical education offers an interesting comparison with Army education. (A full discussion of this is found in Appendix F.) To begin with, there are almost 500,000 M.D.'s in the United States, a population roughly equivalent to the contemplated size of the Army. There is a widely scattered workforce that cannot be easily moved for centralized training. A variety of specialized tasks have special educational needs. The medical profession is increasingly technology-driven, with an accelerating pace of change. Finally, education is directly tied to performance.

The medical profession has used a variety of multimedia educational technologies in basic medical school programs. Perhaps the most revolutionary is an attempt to use virtual reality to "practice" operations. The Panel received a briefing from Eisenhower Hospital on the use of satellite video to "share" medical expertise; for example, a doctor in Haiti can consult with a renowned expert at Eisenhower.

In general, physicians cannot take time away from their practice for traditional centralized schooling. In fact, no such school exists. This contrasts with the Army's system, where a typical officer may spend over four of his first twenty years in Army or civilian education. However, physicians continue to update their education through a variety of formal and semi-formal programs presented, typically, by local hospitals. In addition, physicians qualify for certification by passing board examinations. Many times a group of doctors will "fall in" around a recognized preceptor in the area to collegially prepare for the board examination.

There are a number of lessons and models in medical education that deserve careful study by Army educators as they plan the education system of the future.

H. CONTINUING LEGAL EDUCATION (CLE)

It might be expected that law would be another profession to have a strong continuing education program that could yield some lessons for future Army endeavors, but apparently this is not the case. CLE is controlled on a state-by-state basis. Forty states require CLE, but much of the presentation is in the traditional classroom mode, augmented with videotapes.

The American Bar Association (ABA) does have an ABA-Net Bulletin Board, but its function is not to deliver continuing education; rather, it serves as a medium for information exchange among participating lawyers. Some states have experimented with delivering CLE through live interactive computer systems. Nebraska, for example, uses the state's Higher Education Network for this purpose. The sharing of existing electronic networks for diverse purposes may in itself serve as a small lesson for the Army.

I. ELECTRONIC MEDIA CONFERENCES

Electronic media conferences may be characterized as "mini-education." Companies using remote conferences face many of the same obstacles that the Army will encounter. At the present time, electronic media conferences may challenge the organizational culture, and place power in the hands of media experts rather than subject-matter experts. The latter may not be able to operate all of the "gadgets" without the assistance of media experts, and at times media experts end up dominating the interchange process simply because of their technological expertise. Electronic conferences are primarily group processes, whereas many companies are accustomed to individual processes; i.e., one individual making decisions. Group incentives and rewards, and the inherent difficulty of working collaboratively, are forces which work against electronic media conferences. (These problems are not unique to such conferences, but they may be multiplied due to the geographic remoteness of the participants, in contrast to the conventional group discussion.) However, companies are increasingly utilizing such methods, as travel costs and the difficulty of gathering top executives in one place become prohibitive. Developments in software, and the fact that PC's now have video reception and broadcast capability, suggest that the use of electronic media conferences will increase. This is yet another area the Army must examine for its future education system.

IV. LEARNING PARADIGMS

A. INTRODUCTION

In the forest of computers, video disks, virtual reality, and the like, it becomes easy to forget that the fundamental purpose of this hardware and software (and of this Study) is to enhance learning. Learning technologies are not an end to themselves, but a means to better education and better learning.

General Sullivan reminded the ASB Study Panel that "I want an Army of learning organizations" (8 September meeting with the former CSA). The question then becomes, What is learning? Related questions, of course, are: (1) How do people learn? and (2) How can the Army provide the environment and resources to learn in the future?

General Sullivan's desire for a knowledge-based Army is paralleled in the civilian sector. Herbert Hague (Beyond Universities: A New Republic of the Intellect) notes, "The knowledge society requires people who can reach good decisions, cope with new environments, spot new rules--human and physical--as the world changes. The objective of education, therefore, should now be to inculcate what Toffler calls 'cope-ability' in a world where change is more rapid than ever."

A civilian corporation states:

> The individuals...more than anything else must be full time learners. Simple skill development is not enough for the continuous and radical changes...any such skill can be rendered obsolete or irrelevant. Rather, participants must learn how to learn. They must be equipped with the conceptual skills required to deal with perpetual change. And they must be armed with the technology needed to put this ability to work.

> One way Lenscrafters helps this learning process along is by making the acceptance of mistakes one of the company's core values. "It's OK to fail in our corporate culture as long as you try ideas and have something not work, as long as you learn from it and the company learns from it...Accepting mistakes is important. It removes fear. It encourages innovation."

If the company, Lenscrafters, were not identified in the quote, it might well be surmised that this is a statement made by General Sullivan.

B. WHAT IS LEARNING? WHAT DOES IT MEAN TO SAY, "I HAVE LEARNED SOMETHING?"

The figure below models the Panel's understanding of the human learning process. The essence of learning in this model is:

- A set of questions reflect a problem to be solved, a dilemma to be resolved, or a challenge to be met.

- These questions in turn lead to a theory, and an investigation of possible ideas to solve the problem/resolve the dilemma/meet the challenge.

- These ideas are then subjected to testing: What works? What does not work?

- Reflection follows this testing. An explanation of what went right and what went wrong is provided. This is the equivalent of the Army's after-action review.

The following quotation presents a good definition of learning:

> Learning is not finding out what other people already know, but is solving our own problems for our own purposes, by questioning, thinking and testing until the solution is a new part of our lives. (Source unknown).

A MODEL OF LEARNING
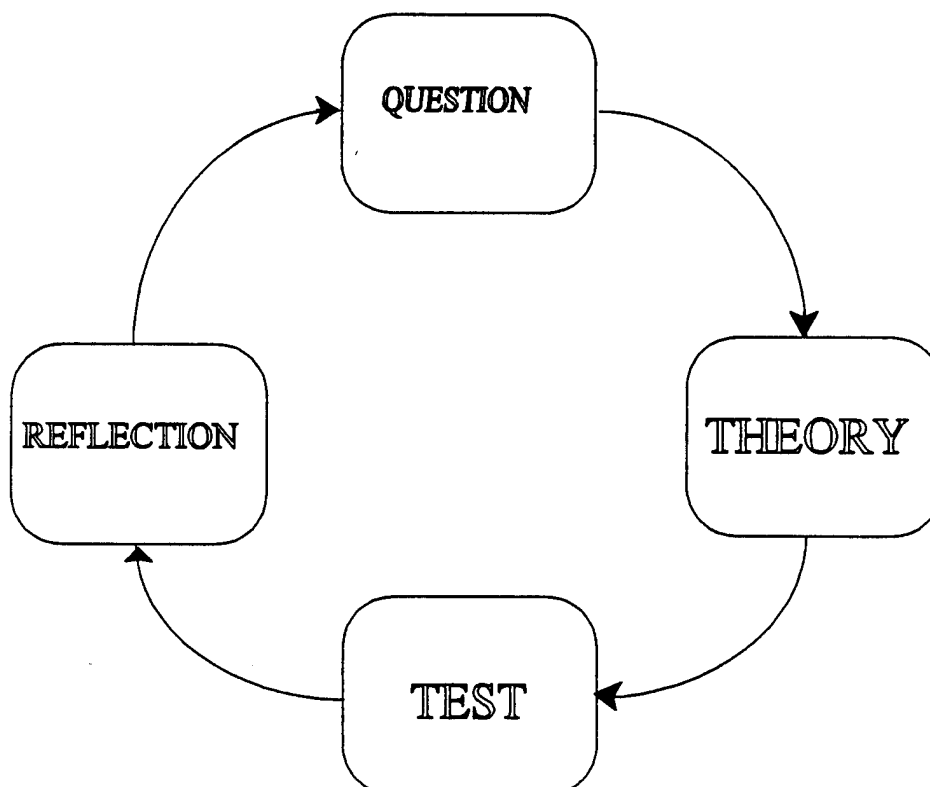
One outcome of learning may be likened to creative problem solving. Why is a senior officer better able to solve a tactical problem than a young second lieutenant? The answer in most cases is experience. The officer has seen the same, or similar, situation many times over in the course of his/her career.

How can the Army provide this knowledge, this experience? There are many ways:

- Provide real experience.

- Provide a "virtual" experience. Examples are the Conduct of Fire Trainer (COFT), aircraft flight simulators, and DIS.

- Provide access to what authors call "know bodies," an apt name for experts.

- Provide access to data.

The access to "know bodies" is, of course, not new to the Army. However, modern communications allow unprecedented interactions. A communications network will result in increased and wider-spread use of expertise as:

> "...expert knowledge among technicians is less a matter of what each individual knows than of their joint ability to produce the right information when and where it's needed. Anecdote, example, analogy, and encounter are the essence of collaborative expertise...In other words, expertise is a social affair." (Schrage, The Shared Mind.)

One of the exciting features of the Internet is the large number of bulletin boards that enable communication among literally hundreds of specialized interests. The Panel only saw one example of such an electronic bulletin board--at Fort Eustis. This would seem to be a natural avenue for the Army to pursue. The Panel was pleased to learn during the writing portion of this Study that the Army has increased its efforts to provide some electronic bulletin boards for "information highway" interchanges.

The future will, without doubt, see all Army officers using a computer-like device connected to a network such as the Internet. The Panel would suggest that even today the Army should require all officers to have a computer linked to the Internet, much as an officer is expected to have a telephone. Possession of a computer implies the ability to use the computer. This computer literacy could be established by qualification tests at entry to the Basic or Advanced Course, or by instruction in the courses.

> The Panel recommends that the Army require an officer to have a computer upon entry into the Service; to be computer literate; to possess certain software packages; and to be linked to the Internet.
>
> At a minimum, the Army should provide an officer with a computer and a common suite of software upon his/her entry to Fort Leavenworth. The officer would retain the computer and software for his/her future assignments.

Three alternatives apparently exist for funding these computers. First, the computer could be similar to TA20 equipment and, hence, belong to the government but be under consignment to the officer. Second, the Army could simply require each officer to own a computer, much as he/she is expected to have uniforms or other items of Army use. Third, the Army could charge tuition to attend Fort Leavenworth, with the computer being bought with all or part of the tuition.

C. GROUP LEARNING

Modern communications also allow a greater degree of cooperative learning. The Army has used group discussions in Service schools for some time; however, true group learning is a somewhat different proposition. In "Learning Through Cooperation," an article by Vincent Ercolano which appeared in the November 1994 issue of ASEE Prism, cooperative learning is defined as "instruction that involves students working in teams to accomplish a common goal, under conditions that involve both *positive interdependence* (all members must cooperate to complete the task) and *individual and group accountability* (each member is accountable for the final outcome)." (Note: Emphasis appears in the original article.) Group, or cooperative, learning differs from a discussion group in that each member of the group is responsible for the group's learning. For example, a commitment to true group learning implies that CGSOC would recognize an outstanding group rather than an individual. Research has documented the efficacy of group learning. The Army should emphasize group and cooperative learning in future education.

The Army has a long-standing program with the Army Research Institute (ARI) to foster new methods of training and education. Many of these methods have proven to be very successful. The Panel suggests that the Army carefully examine the greater use of proven techniques for educating and training groups (such as Reserve Officer Training Corps [ROTC] classes).

D. AN ARMY-UNIQUE CAPABILITY

The Panel believes that the Army's interest in digitization, simulation, and DIS can lead to a unique educational opportunity. The scenario goes as follows: Sometime in the future, somewhere in the world, an Army unit is involved in a tactical operation. Digitization allows the

Army to capture in great fidelity all the elements of the operation. Once the operation is reduced to digital data, the data can be processed through a "simulation creator" to produce a real-time simulation of the operation. In the near future, this simulation can be virtual reality. It can be archived for future use and study, or presented immediately to "know bodies" for advice or critique.

This is indeed a unique capability, as few other educational institutions have the capability to produce sophisticated simulations of DIS. Few have the extensive worldwide communications network, and few are attempting to digitize what amounts to experiential learning.

> The Army's simulation capability, technology thrust in battlefield digitization, and use of digital compression techniques will allow true-fidelity capture of all operations and activities for:
> — Instant interaction, critique, or advice;
> — Archiving for future educational use.

The Panel would note that simulations such as COFT appear to be eminently successful, in that tank gunnery scores improved after gunners spent time in COFT. However, it may not be true that all virtual experiences translate into improved real achievements.

E. THE SPECTRUM OF OFFICER EDUCATION

Hague answers the question, "What are universities for?" by stating that they:

- Generate curiosity;

- Encourage lateral innovative thinking;

- Arouse excitement;

- Develop students with "the future in their bones." (From C.P. Snow)

A fundamental question, then, is, "Why do officers attend the Army 'University'?" In addition to the general reasons stated above, the Army University also provides hands-on training, a standardization of approaches, and the creation of a social experience and network.

An officer needs hands-on experience early in his/her career. This experience includes the use of basic weapons, maps, communications equipment, etc. Presently, the Army School System provides much of this experience; however, much, if not all, of this responsibility could be shifted to an officer's unit. Later in his/her career, an officer has a fuller appreciation of what knowledge is required in his/her current position, and in the position to which he/she aspires. This realization argues that an officer could secure some of this education remotely and individually, if the data bases and "know bodies" existed and if access to them were provided. However, there is an

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increasing need for social networks as an officer moves through his/her career. Most officers find the personal contacts established at CGSOC and the Army War College to be extremely useful in later command and staff positions; this argues for a group experience. Any use of technology must preserve this important element of an officer's educational experience.

Army faculty are somewhat different than civilian faculty. As a rule, Army faculty do not spend long periods of time as instructors. In addition, Army faculty may only be marginally more proficient in the subject matter than the student. True expertise is widely dispersed throughout the Army, not merely concentrated at Army Schools. An officer, as part of his/her education, may have a question about logistics in the desert, for example. The ability to interact with an expert on this topic residing at Fort Hood through two-way audio/video would be an effective learning mode. (In fact, even the CSA suggested that he should be available for such consultation!) An inventory of experts and development of an electronic network would allow access to these "know bodies."

> The Army should have an inventory of people and associated areas of expertise so that officers will know where to go to access the "know bodies" he/she needs for his/her education.

V. THE FUTURE VIEW

A. INTRODUCTION

> For now we see through a glass darkly, but then face to face:
> now I know in part; but then shall I know....
> -- Corinthians I, Chapter 13, Verse 12

General Sullivan asked that this Study look at the year 2012, seventeen years into the future. Seventeen years ago it was 1978; what would a prognosticator have forecasted for the year 1995? Many of today's wonders then resided on laboratory benches, but would some brave soul have bet on the reality of an Internet, with some twenty million users scattered around the world? The ubiquitous PC, with more power than a 1978 mainframe? The widespread use of CD-ROM technology? Hypertext? Extended use of color and animation? Software packages that "do" calculus? The Sprint voice-activated Fone-card™? Desktop publishing? Portable phones? A DIS that allows simultaneous training at geographically dispersed locations? This would have required a prescient observer, far better than the Study participants. The Panel looks to the future with some hesitation, and recognizes that many of its conclusions and recommendations may merely be stepping stones to an environment that is far beyond its members' imaginations. Study participants, like many others, may exhibit linear thinking when exponential thinking is in fact required. Therefore, the Panel should be excused if it widely misses the mark in this forecast.

The Panel is apparently not alone in this inability. AT&T has produced a videotape, entitled "Connections," which is its vision of the future (available from the Faculty Development Office at Fort Leavenworth). This videotape is well done. However, nearly all of the technology described on the tape exists today, at least in an embryonic state.

Appendix 10 in the Supplement contains a paper prepared by the Information Technology Laboratory (ITL) of the U.S. Army Waterways Experiment Station (WES) in Vicksburg, Mississippi. This laboratory is probably unique to the Army, and the paper describes the organization's view of the future.

The ITL paper is biased toward distance learning (the Panel shares this bias), and suggests that the following technologies and capabilities will exist to support Army distance learning:

- Two-way video;

- Full duplex audio;

- Interactive, multi-point, concurrent whiteboarding;

- Digital video-on-demand servers;

- Wireless, cellular connectivity;

- Long-haul networked personal computers and workstations, with network connections costing the equivalent of a local phone call.

B. HARDWARE/SOFTWARE

The Panel hesitates to call the computer the "machine" of the future. J. Lewis Perleman (School's Out: Hyperlearning the New Technology, and the End of Education) has described a "...telescom communication infrastructure that makes all knowledge accessible to anyone, anywhere, any time. The telescom takes the most powerful knowledge, intelligence, and learning capacity in an environment that would otherwise be only local, and makes it global. For both human and non-human learning the telescom makes the 'best and brightest' located anywhere available everywhere."

A common consensus is mobility and portability. Whatever the device may be and however it may communicate with other people or data bases, it will follow its owner. Bandwidth will no longer be a factor. The ITL paper reports that a single video frame, which contains 96 million bits of information, would require 25 minutes of transmittal time using today's 64Kbps voice links. However, a gigabit network, which is expected in the next five years, would transmit the same frame in a tenth of a second. In addition, present and future predicted algorithms can reduce the bandwidth requirement by a factor of 20 or more. Therefore, either the incoming information will be compressed, or the "pipe" bringing in the data will be large enough to handle any imaginable amounts of data. This "telescom," to borrow Perleman's term, will be an all-purpose machine. No longer will the instructor require a television, computer, VCR, etc. The telescom will respond to voice commands, and will give audio translations from one language to another. Many suggest the world will be paper-free.

Software will no longer exist in today's sense of the word. Something akin to neural networks will be used to exploit the electronic interworkings of the telescom. There may well be direct or indirect connections from the human brain to the telescom. Electronic archiving will allow the access to information that Perleman described. A "personal agent," that is, a program that mimics an individual's behavior pattern, will be the norm for each telescom. These personal agents will make decisions in the absence of their "owners."

> **Virtual reality will be a certain reality.**

The Panel repeats its strong feeling that:

> The Army's simulation capability, technology thrust in battlefield digitization, and use of digital compression techniques will allow true-fidelity capture of all operations and activities for:
> — Instant interaction, critique, or advice;
> — Archiving for future educational use.

Cognitive science, molecular psychology, embedded training, and neural networks will all play a role. In addition, pharmaceutical enhancement of creativity, memory, and learning can be envisioned. A better set of psychological tests could also be an interim measure to predict qualities of leadership and decision making.

Finally, there will be any number of pedagogical advances. Educators will more effectively use methods such as group learning, structured pathing, simulations, and individually "tailored" programs to enhance students' learning.

VI. ORGANIZATIONAL CONSTRUCTS

A. INTRODUCTION

There has been extensive discussion in the last few years regarding "re-engineering," "downsizing," "flattening the organization," "value-added activities," and other similar terms. Whichever term is used, the net effect, generally, is a smaller, more focused organization. TRADOC will have to hew to these concepts. The contemplated 495,000-man Army will not support a TRADOC University with a faculty and student body the size it is today. Educational technology has the capability to help the Army achieve a slimmer, more effective education sector.

The Panel wishes to emphasize that the following discussion on organizations only treats the educational role of TRADOC and the TRADOC School System. The Study Group did not look at School activities such as combat development, and claims no competence in such matters.

The Panel believes that the constructs suggested herein will serve as a bridge from the present conventional education organization to the distance learning system of the future, and that they will be satisfactory for the presentation of distance learning.

B. THE SHAMROCK ORGANIZATION

One organizational concept that appears to have considerable merit is the shamrock organization, so-called because the three "groups" of individuals which make up the organization are analogous to the trifoliate shape of the shamrock. The primary group in this organization is a small set of individuals with core competencies; for the Army, this group would be the war fighters. There is also a group of regularly used "contractors"; the implication here is that this group is primarily dedicated to one organization. Analogous Army groups might include reserve units that furnish combat support or combat service support. It might also include contractors, such as RAND, who are "regularly" used by the Army for study support. The third leaf of the organization is an irregular group of part-time workers; the implication here is that these employees work for any number of organizations. There is perhaps no Army equivalent to this group right now, although the Active Guard and Reserve (AGR) positions may come the closest. The necessity for part-time workers also suggests that the Army needs a better inventory of skills in order to quickly identify workers required for a particular assignment.

The TRADOC Schools could very well be a shamrock organization. Army cadre would teach a small subset of unique Army topics. Contractors such as local colleges would teach some part of the curriculum on a regular basis. For example, colleges could teach the English and speech courses that are part of some Programs of Instruction (POIs). Local health club instructors may be well-trained in exercise physiology, and could present the physical training classes. The Panel is convinced that the entire curriculum of the Army Computer Science School at Fort Gordon could be presented by a local college or university, or by distance learning from the finest colleges in the United States. Finally, the shamrock organization suggests that "one-time" lecturers would fill in the holes. For example, outside experts may be asked to present a

lecture, and several Army school POIs contain history or heritage lectures which might be presented by local retirees.

C. FLATTENING THE ORGANIZATION AND USE OF DISTANCE LEANING

Elimination of layers of management would be possible under at least three scenarios.

The first scenario would be the elimination of TRADOC. This would result in the School Commandants reporting directly to Headquarters, Department of the Army (HQDA). This would seem to involve HQDA in operational rather than policy matters, and would perhaps be inimicable to the officer education system.

The second possibility would be the elimination of Fort Leavenworth and Fort Lee. This is feasible; the Branch Schools would report directly to TRADOC. Many have argued that the integrating centers were never effective, and that the integration of officer education could pass to TRADOC. However, a description of an organization that seems preferable to the first two scenarios follows.

This last option would involve the elimination of the Branch Schools and Fort Leavenworth as geographic entities where officers gather to gain knowledge. This seems revolutionary, but the Panel is convinced that the Army will have to utilize distance learning. The Panel suggests a plan much like NTU's. Fort Leavenworth and Fort Lee would be managers of education. An officer's education would become the responsibility of his/her unit commander and his/herself. The Army has characterized officer education and leadership development through a three-pillar model, as shown in the figure on the following page. Each pillar in this figure holds equal responsibility for the officer's education. Under the Panel's plan, the three pillars do not disappear; however, the operational assignment and self-development pillars become significantly more important. The relative width of the pillars in the second figure conveys this concept.

The Panel describes this new education scheme as a "managed apprenticeship." For combat arms officers, Fort Leavenworth would develop certain "board tests," much like the medical boards. It would also be responsible for certain system-wide lectures on specific topics, as well as for identifying "know bodies" and other sources of information. However, the unit commander and the individual officer would be largely responsible for the officer's education.

It must be asserted that this scheme may be satisfactory for the Officer Basic and Advanced Courses, but it removes the opportunity for social networking that is important at CGSOC. Again, the Panel feels that the Army must embrace distance learning, and that the present method of gathering 1000-plus officers per year at a central location will no longer be possible. Obviously, officers at CGSOC do not network with all 1000 of their classmates. Most experts have suggested that 50 is a good number for effective collaboration and networking. This suggests that the Army could create 20(±) "clusters" of officers who would be using group techniques and collaborative learning for completing CGSOC. Fort Hood, for example, could be a cluster of officers participating in CGSOC. Many of these officers would have Fort Hood as a

ARMY LEADER DEVELOPMENT MODEL

INSTITUTIONAL
TRAINING &
EDUCATION

OPERATIONAL
ASSIGNMENTS

SELF
DEVELOPMENT

EDUCATION
& TRAINING

REMEDIATION & REINFORCEMENT

ASSESSMENT

FEEDBACK

STANDARDS AND EXPECTATIONS

VALUES AND ETHICS
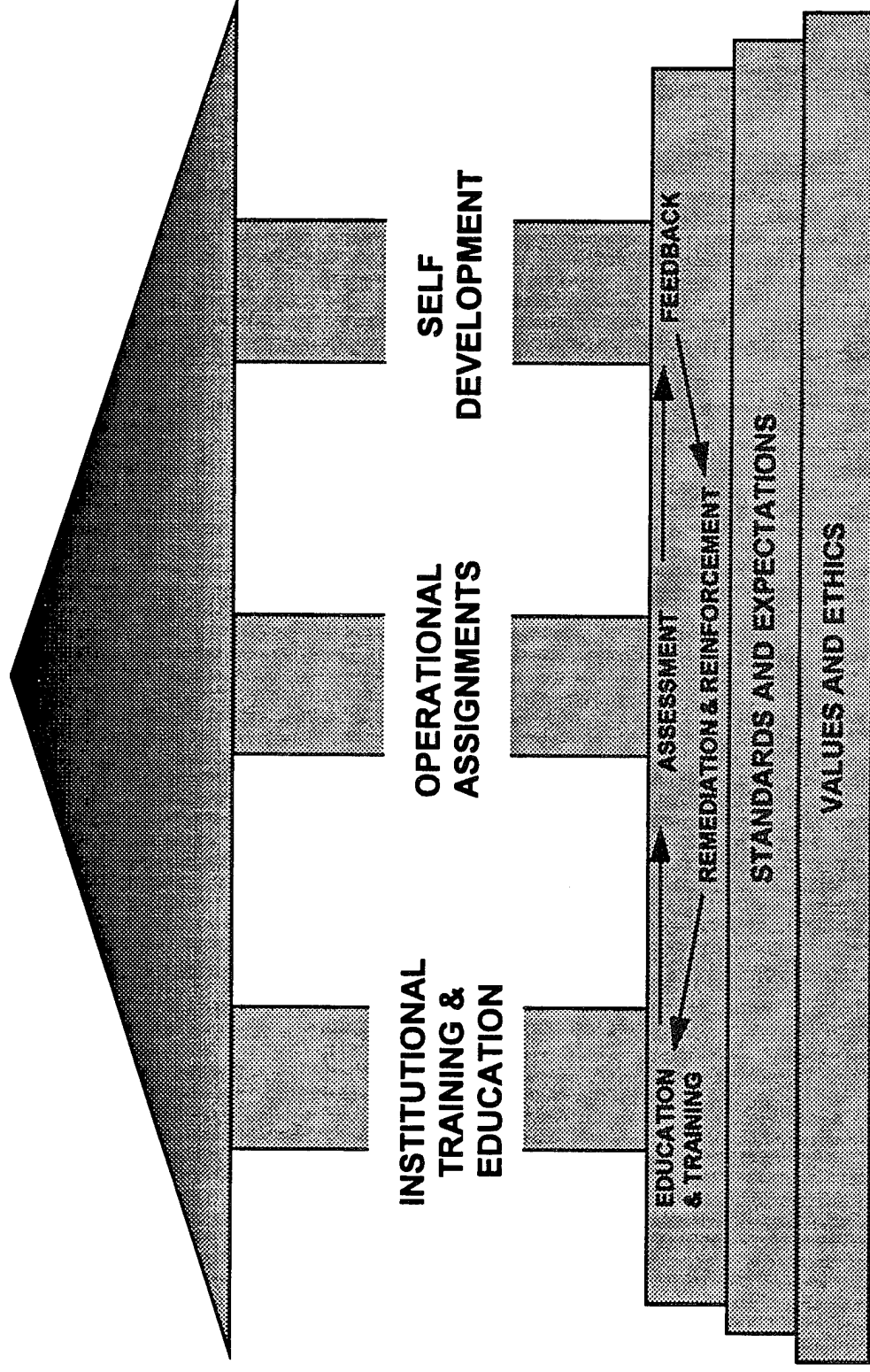
THREE PILLARS...INTERCONNECTED...PROGRESSIVE AND SEQUENTIAL

FIGURE 1

ALTERED LEADER DEVELOPMENT MODEL

INSTITUTIONAL TRAINING & EDUCATION

OPERATIONAL ASSIGNMENTS

SELF DEVELOPMENT

EDUCATION & TRAINING

ASSESSMENT

REMEDIATION & REINFORCEMENT

FEEDBACK

STANDARDS AND EXPECTATIONS

VALUES AND ETHICS
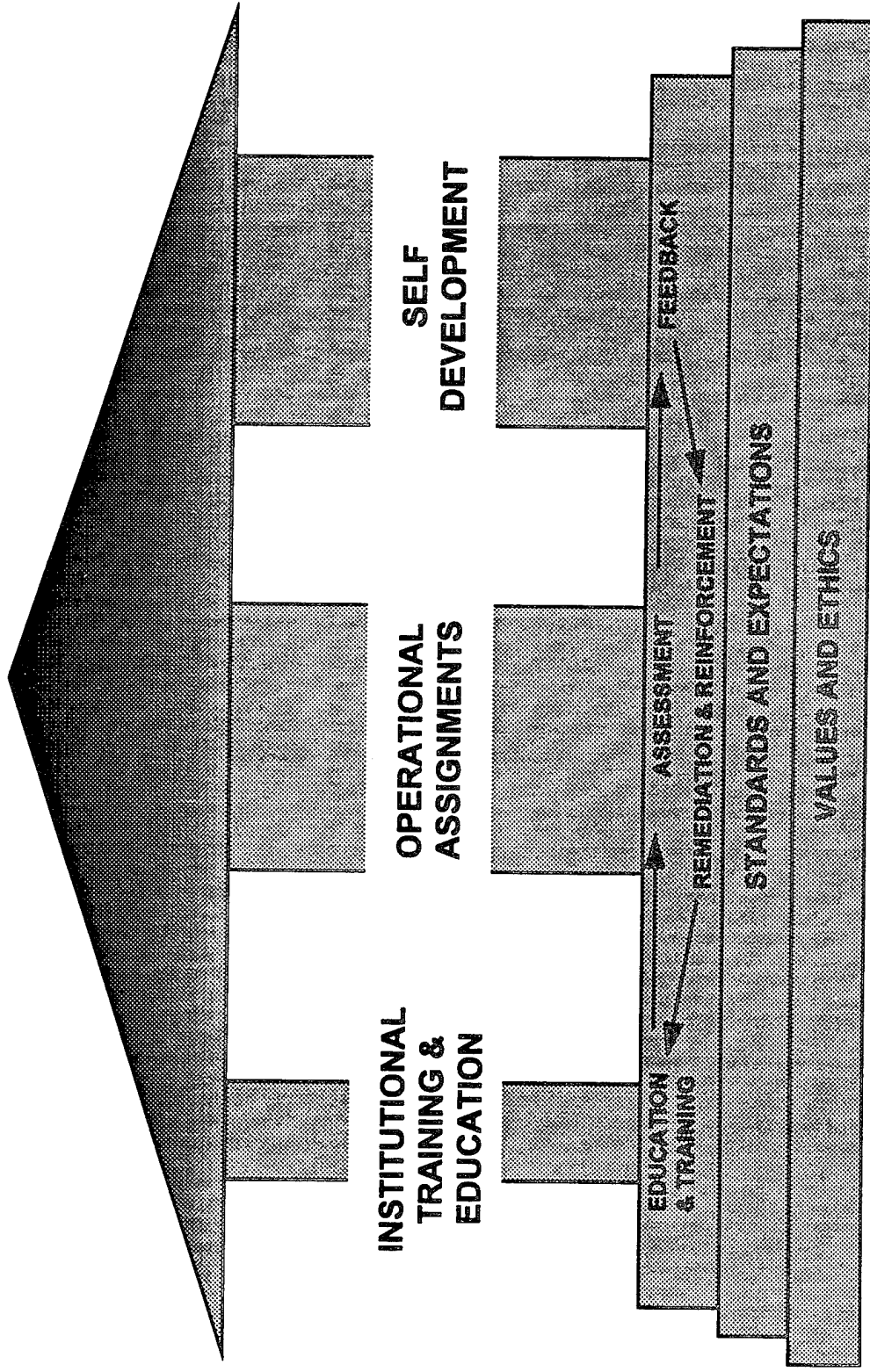
THREE PILLARS...INTERCONNECTED...PROGRESSIVE AND SEQUENTIAL

FIGURE 2

home station. Others might be from Fort Sam Houston or other installations close to Fort Hood. Appendix H contains examples of possible clusters.

The Army could bring all of the clusters together at one location for a short period of time if desired. However, the ability to exchange views and information through two-way audio and video suggests that geographical "togetherness" is not a necessity for effective networking.

The Army School System was designed some time ago, with the desirable and necessary goal of assembling officers in a single geographic location to offer a common and unified approach to Army doctrine, tactics, and problem solving. Educational technology enables the Army to bring the School to the student, rather than the student to the School. This approach requires that the Schools become "managers" rather than "providers" of education. This would parallel NTU's system, where a large number of courses are presented by faculty who are widely scattered geographically rather than being on-campus. An alteration of General Sullivan's pillars indicates that the responsibility for education would shift to the unit and the individual, with the Schools playing a much smaller role. This approach would be consistent with new management philosophies and would effectively utilize technology.

"Know bodies" and preceptors would deliver lectures as needed to either local audiences or to a more global audience over the Army's TNET. Distance learning also has the advantage of saving an enormous amount of annual temporary duty (TDY) expenses. In addition, distance learning provides the opportunity for asynchronous presentation. This would replace the present correspondence course, and would basically enable all officers, if they so choose, to attend CGSOC.

VII. OBSTACLES

A. INTRODUCTION

The TOR asked that the ASB Panel identify barriers to the introduction and use of educational technology within the Army School System.

B. LEGAL

Appendix I contains an analysis of the Brooks Act. This act, which may have been appropriate at a time when the government was buying large mainframes, does not seem to belong in today's PC world. The act places a large number of *a priori* criteria on computer procurements, forecloses the opportunity to lease computers, and, in general, will ensure that the Army never receives state-of-the-art computers. (A related problem is the long length of the procurement cycle. Any procurement action that stretches over two years, as is apparently the case at some installations, will result in the purchase of outdated hardware.) Admittedly, there are a number of ways around this act. One method is to use the blanket purchase agreement that the Services and the General Services Administration (GSA) have negotiated. Also, the Army, by one means or another, has managed to write a contract with OSU to provide and manage the TNET. However, working through DoD, the Army should prevail upon Congress to rescind or modify the Brooks Act. Buying a PC these days should be the equivalent of buying a chair or a table for the office.

C. FINANCIAL RESOURCES

The price of hardware and software which are used in educational technology is rapidly spiraling downward. Nonetheless, the initial cost can still be appreciable. The Panel earlier noted that the Advanced Technology Classroom at West Point costs over $500,000. There was no budget to sustain orderly replacement of equipment that may have a technical half-life of two to three years. At Fort Gordon in particular, Panel members felt that educational technology efforts had receded over the years due to TRADOC's reduction in personnel and funds. This cutback particularly hit training developers, who should be the leaders in educational technology. Educational technology is not cheap. Once involved, the Army must budget to stay involved.

A particular expense deserves special mention here. The creation, maintenance, upgrading, assessment and testing of courseware is a cost that will likely be much greater than educators now recognize.

D. THE GOOD OLD DAYS AND THE NOT-INVENTED-HERE SYNDROME

Some in the Army have not fully recognized that the halcyon days of resources are over, and the day is now here when budgets will be dramatically lower. Imagination, creativity, and

sharing of assets will be necessary. The Panel found instances of failure to recognize that assets were in place to solve certain problems--assets that would need to be shared. The Army has several networks in place; TNET and the Simulation Network (SIMNET) are two examples. The Panel found no technical reason for having multiple networks, only a desire by commands to own and control their own facilities. While the Panel applauds the Army's TNET, it duplicates existing civilian capabilities. The "not-invented-here" syndrome is understandable and hard to overcome. However, the Panel's feeling is that some Army personnel are looking for fiefdoms, not fixes; for sinecures, not solutions; and for ownership, not "shareship."

E. CULTURE

Appendix 11 in the Supplement outlines the difficulty of introducing technology into the classroom at Fort Leavenworth. All Army instructors carry an inordinately heavy teaching load. Some have been teaching the same subject in the same manner for a long time. Some are not computer literate; some do not want to be computer literate. All of these factors work against the introduction of educational technology. In other words, there may be an institutional bias against new methods and structural reform.

F. FACULTY TRAINING

One method of overcoming this bias is to adequately train the faculty of the Army Schools. Fort Gordon and West Point demonstrated that the use of educational technology takes a significant amount of faculty indoctrination and training. It cannot be assumed that a conventional classroom teacher will automatically be a good educational technology teacher. In addition, it is clear that the initial preparation time for a high-technology lesson far exceeds that needed to develop a conventional lecture.

Multimedia education adds new dimensions to the education process. A professional is needed who understands the aspects of this media. A teacher is needed who understands the subject content. The educational technology that will soon be available is not merely a "computer replacing a typewriter." It is indeed a complete change in the process of thinking and handling information. This change will take time, money, energy, and a full commitment by the Army to "stay the course."

The Panel also suggests that, at least for the time being, an educational psychologist is needed to provide meaningful assessments of education experiments at the Schools. Panel members saw only the beginning of such assessments in Army activities.

G. INSULARITY

The Panel noted a number of strong interchanges between Army educators and the civilian world. However, there were some peculiar exceptions. One briefer reported that the activity did not need to look to the outside world as, "We do it better than anyone else." The "Satellite

Scholar" (P.O. Box 3508, Missoula, MT, 59806) is the "TV Weekly" of satellite education. Yet the Panel was unable to find a single Army subscriber. This would suggest some lack of familiarity with the full spectrum of education available from the civilian sector.

H. QUESTIONABLE CLAIMS

The issue of the assessment of educational technology was previously discussed. Many educators are not prone to commit a large amount of funds, faculty time, and other resources to technology fixes that may or may not be better than present methods.

I. COMMAND INSTABILITY

Few college presidents remain at an institution for as few as two years. Yet this is the norm for many School Commandants. It was previously noted that the position of Deputy Commanding General at Fort Leavenworth has turned over four times in five years. **It is difficult for any technology thrust or organizational change to persist in such a situation.** Some permanent personnel at Army Schools have an interest in preserving the status quo, not rocking the boat or pushing for change. The Army therefore has a recognized dilemma. There are only so many "bright lights"; however, if education is indeed important (and the Panel suggests it will become even more so in the years to come), then the Army simply must put its "best and brightest" in the TRADOC University, and leave these officers there for an extended tour.

J. OPERATIONAL BIAS

Army units traditionally have a penchant for "mission" activities, which translates into operational activities. In the past, education efforts such as encouraging non-commissioned officers (NCOs) to complete the Graduation Equivalency Diploma (GED) requirements during duty hours have been significantly weakened by the attitude that an NCO was a "shirker" if he/she was at the Education Center rather than with the unit. A significant shift of responsibility for officer education from TRADOC Schools to units will thus require a significant change in the Army's culture. A commander's efficiency report should include a sizeable evaluation of his/her success in fostering officer education on the part of his/her subordinates.
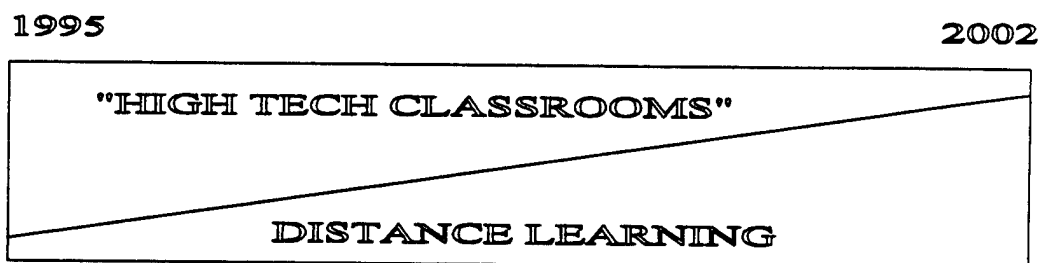
VIII. SIGNIFICANT FINDINGS

1. Educational technology will be an enabling force that will allow the Army to make changes in its present education system--changes that appear certain in the face of BRAC and a smaller Army.

2. The Army's major use of distance learning is fore-ordained. Advancements in two-way audio/video transmission and digital compression, along with cheaper satellite time, will allow for effective education, group participation, and at least some of the networking that is prevalent in the officers' courses today.

3. In addition to the rapid development of the hardware and software of educational technology (the delivery end), there is an equally rapid development in learning paradigms (the receiving end). Many of these methods, such as cooperative learning, were originally fostered and supported by ARI, but the Army could use the techniques more effectively in its School System. Additionally, the Army School System is being extended to new audiences, such as the ROTC program, that could benefit from educational technology.

4. The Army is engaged in an enormous flurry of activity in educational technology. Such experimentation may be good, but the Panel is uneasy regarding the lack of focus or direction. In addition, some installations have actually regressed in their attention to and use of technology due to TRADOC resource cuts.

5. The Army's efforts, despite their enormity, are dwarfed by the totality of civilian educators' interest in and use of technology. The Army should be a major player on the national scene in educational technology, and joint research efforts with civilian educators are both desirable and possible. The Panel was uncertain whether there is enough Army awareness of the total extent of civilian efforts. Panel members also note that some Army programs seemingly failed to adequately consider cooperation with or use of civilian resources. Such sharing of resources will be necessary in the context of budget limitations.

6. The Panel found little evidence of inter-Service programs or ventures. There is considerable interest within DoD as a whole in utilizing educational technology, and the thrusts for joint and cooperative programs among Services should include efforts to use educational technology effectively, and to preclude duplication of equipment, research and development efforts, and training.

7. The Army is not taking full advantage of existing educational technology. For instance, the Panel was surprised at the Army's inadequate use of electronic bulletin boards. These bulletin boards could support a variety of cohort groups. For example, Infantry Brigade Commanders could use one board, adjutants another, etc. The Army could move quickly to establish these collaborative educational means; late in the Study the Panel was led to believe that some efforts are underway to use this technology.

8. A move toward distance learning and a "leaner, meaner" Army School System requires a concomitant organizational change. A flatter organization would require the elimination of either TRADOC, Fort Leavenworth and Fort Lee, or the Branch Schools--or some combination of the three. A related organizational change would be a transformation to a shamrock organization. This type of organization includes a small set of full-time employees devoted to the core activities of the organization, a group of regular contractors, and a number of "irregular"--i.e., "as needed"--contractors. The TRADOC Schools could use a shamrock organization as a bridge between the classroom of today and the distance learning mode of the future.

9. The Army has an unprecedented opportunity to achieve effective education by integrating digitization, simulations, DIS, and electronic archiving.

10. Any scheme of dispersed teaching and calling on "know bodies" for lectures, critiques, doctrine development and other tasks requires an accurate and full inventory of each officer's skills, knowledge, and abilities.

11. Throughout this Report, the Panel has commented on the lack of evaluation of the Army's use of educational technology. The Army must develop appropriate outcome evaluation methods that can provide relevant comparative data concerning the quantity and quality of the learning occurring through differing pedagogic techniques. The evaluation has to be conducted over time, in order to measure the long-term effects of educational technology. How long is the material retained? How is it useful throughout the course of an officer's career? Is book and classroom learning more effective for long-term retention? Is interactive computer-based learning a better way to have students participate in the learning process? Or is pure experiential learning most effective? These are difficult questions, but their complexity should not hinder attempts to answer them.

12. Similarly, the Army must review the full range of alternative delivery systems for education, and evaluate these systems in light of the Army's educational needs at a particular level, for a particular course, and at a particular time. The Panel did not see much evidence of such an assessment. Instead, Panel members came away feeling that technology is driving some change where it is used, rather than educational needs driving technological alternatives. More often than not, officials continue to rely on older methods based on habit and past experience, rather than considering and consciously choosing from among various alternatives. The choice of the UMR Engineering Management Program by Fort Leonard Wood is one example of this.

13. The Army must conduct a more careful evaluation of the role of social networking and the relationships that develop in the traditional classroom. What impact will a shift to distance learning technologies have on the bonding which now occurs among the officers? How serious would the loss of this social community be? How can the best of educational technology be utilized while maintaining the necessary social and human interaction? These are critical questions which are not currently being addressed.

IX. RECOMMENDATIONS

The Study recommendations are:

1. Continue to develop and acquire modern classroom technology, but emphasize a move toward distance learning. A notional time table for this effort is shown below:

1995   2002

"HIGH TECH CLASSROOMS"

DISTANCE LEARNING

This illustration conveys the sense that the Army now utilizes some distance learning, with a preponderance of modern classrooms. By 2002, the Panel recommends that the Army move to a small proportion of modern classrooms, with a much greater use of distance learning. It further recommends the use of distance learning for the Basic and Advanced Courses and CGSOC. Distance learning will supplement the education which will be provided at the unit level for the officer's Basic and Advanced Courses. CGSOC "clusters" will use distance learning as a primary mode. All of the education will emphasize group learning.

2. Make the commitment to move to the electronic classroom and distance learning. This includes committing to:

    a. Continuity of leadership.

    b. Training the professional staff at the various Schools so that they are comfortable with the new technologies, and can effectively incorporate educational technology in rethinking the objectives of education.

    c. The identification and recognition of a cadre of teaching professionals who will champion the approach throughout the School System.

3. Coupled with the technology's introduction must be the realization that the Army will have to develop appropriate outcome evaluation methods. In addition, the Army must seriously review the full range of education delivery systems and evaluate these systems in light of its educational needs.

4. While the Army could use the TNET as the basis of distance learning, the Panel recommends that existing civilian resources be explored as alternatives. Local cable companies have provided cable at many installations which could possibly be used for land-based transmissions. Sharing the facilities of organizations such as NTU may be possible for satellite transmission.

5. Develop the full capability of the synthesis and synergy possible with digitization, simulation, DIS, and electronic archiving.

6. Develop joint research and study efforts with a variety of civilian institutions, such as NTU and IAT, and with the United States Department of Education as well as state Departments of Education. Take the lead as the education champion for joint programs with appropriate organizations within the other Services and DoD. Much of the hardware research and development, such as increase in bandwidth, will come without the need for Army funds. However, the propagation of the new learning paradigms, particularly within the entire Army (ROTC programs, for example), needs Army funding support.

7. Make the organizational changes necessary to implement distance learning, and institute the necessary training to effectively use and present it. The Panel's preference is to establish Fort Leavenworth and Fort Lee as "managers" of education. In other words, their responsibilities would include such activities as developing qualification tests, identifying distance learning instructors, arranging satellite time, etc. This would parallel the national education philosophy of decentralized education with national standards.

8. Eliminate much of the educational role at the Branch Schools once distance learning is fully implemented. In the interim, conduct careful tests to determine the appropriate level of Branch School participation in either the managing or presentation of Branch-specific education.

9. Although Panel members do not unanimously support this recommendation, there is some sentiment that the Army should create a Board of Regents or similarly named group to bolster the Army's desire to move toward a "university" system. In addition, the Army should consider creating a provost position at appropriate institutions within the university. If the recommendation to establish Fort Leavenworth and Fort Lee as the managers of education were to be adopted, it would be logical to have a provost at each of these locations. The Army would walk the fine line between ossification and instability by following a procedure such as that used with the Dean of the Academic Board at West Point. An officer

or civilian would be appointed provost for a five-year period, subject to review and either termination or renewal at the end of the period.

10. Move toward the notion of "shamrock" education as quickly as possible. Identify core topics which *absolutely* require active-duty instructors, topics suitable for contractors, and topics suitable for irregular workers. The Army can well civilianize a great portion of its education program. In particular, many retirees have far richer experience in combat, logistics, intelligence, and other Army activities than will exist within the active field-grade cadre of the near future. This suggests the core topics may be quite limited.

11. Continue to develop the electronic bulletin boards as a means of informal education. Require all officers to be computer literate as certified by appropriate testing, to either own or be provided a computer, and to be connected to the Internet. Explore the emerging World Wide Web as an alternative, in order to be more than a bulletin board but less than the two-way audio, two-way video available through TNET.

12. Develop a complete inventory of skills, knowledge, and abilities for each officer in order to rapidly identify experts for teaching or operational situations.

13. In concert with the ASB, prepare an Army Future Education Roadmap and request the National Academy of Sciences Board of Army Science and Technology (BAST) to critique the effort upon completion.

The ASB strongly feels that adoption of this Study's recommendations will place the Army in a role as an education leader in the United States. This is a rightful position for the Army. Acceptance of a lesser role should not be acceptable.

APPENDIX A

ORIGINAL TERMS OF REFERENCE

DEPARTMENT OF THE ARMY
OFFICE OF THE ASSISTANT SECRETARY
RESEARCH DEVELOPMENT AND ACQUISITION
103 ARMY PENTAGON
WASHINGTON DC 20310-0103

REPLY TO
ATTENTION OF

21 JUN 1994

Dr. Walter B. LaBerge
Chair, Army Science Board
2001 Robin Hood Trail
Austin, Texas 78704

Dear Dr. LaBerge:

I request you initiate an Army Science Board (ASB) Ad Hoc Study on "Use of Technologies in Education and Training." The study should address, at a minimum, the Terms of Reference (TOR) below. The ASB members appointed should consider the TOR as a guideline and may include in their discussions and reports related issues deemed important. The study group should coordinate modifications to the TOR with the ASB office.

I. BACKGROUND.

The Army is in a time of expanding roles and missions, decreasing training and education opportunities, sharp limits on procurement, and ever expanding information technologies.

The Army schools have served the country well for many years. Soldiers have received the necessary skills to function as riflemen, tank gunners, wheel vehicle mechanics, cooks, and the numerous other MOS's that are necessary for modern warfare. Young officers attending Basic and Advanced Branch schools have emerged as competent company grade platoon leaders, commanders and staff officers. Fort Leavenworth and Carlisle Barracks have produced senior officers capable of planning and executing complex battle campaigns such as JUST CAUSE and DESERT SHIELD/DESERT STORM. The Army's education and training system continues to be the center piece to prepare our Army for the 21st Century.

In the past, traditional "schoolhouses" embraced early educational and training techniques. Few visual aids existed in the classroom beyond an overhead projector. The delivery medium was a lecture following a carefully scripted lesson plan. Hands-on training for soldier skills such as wheeled vehicle mechanics complemented lectures while officers would perhaps participate in group discussions or map or field exercises (such as terrain walks). The Army's text books were field manuals and technical manuals. While these manuals were informative, one may charitably characterize them as drab, dry, and uninspiring. Each student proceeded at a common pace. Evaluations required the students to basically play back the lecture material to be considered as "passing." In short, the Army followed the instructional mode prevalent in the United States.

However, Army education and training have evolved and continue to be dynamic. The Command and General Staff College's (CGSC) schools, for example, have significantly enhanced their educational methodologies. Education is more important than training. Schools stress how-to-think vice what-to-think and the application of knowledge. Simulations, critical thinking exercises, problem solving/decision making scenarios, subjective essay-type examinations, self-directed study, and active vice passive learning in small group instruction are essential elements of the Training and Doctrine Command (TRADOC) education system. Specific to training, the National Training Centers provide training opportunities in a virtual, synthetic environment - preparing units for success in operations such as DESERT STORM.

Much more will change in the next 20 years. Information technology in its broadest sense will allow almost unlimited freedom and flexibility in providing education and training to soldiers. We are beginning to break through the traditional leader development paradigm that worked so well during the Cold War era. At the heart of this breakthrough is the notion of the leader-student... constantly learning in a learning organization. Rapid changes require leaders to have instant access to the worlds of theory and practice - connectivity of the leader-student to learning institutions, units in the field, and other leaders on demand. Leaders will not stop being students when they leave the schoolhouse. This leveraging of Information Age technology will provide powerful tools for leaders to learn and to train units and soldiers throughout the Army. The Army is carefully analyzing its present education and training strategy to take the fullest advantage of future technology and looks to seize the opportunities to make quantum leaps in its education and training processes.

Allied with this technology explosion is a concern for the requisite technical skills for the Army of the 21st Century. As you know the ASB is presently preparing a study, "The Science and Engineering Requirements for Military Officers and Civilian Personnel in the High Tech Army of Today and Tomorrow." Obviously, this study is closely related to the study I am now asking you to undertake.

Many exciting prospects loom on the horizon. The basic notion of a student coming to the schoolhouse may be replaced by the schoolhouse coming to the student. Learning strategies such as structured pathing, exploratory learning, and extended use of gaming and simulation are no longer theoretical constructs but are in hand. Electronic access to data bases and bulletin boards can be a strong unifying force within the Army. Compact Disc - Read Only Memory (CD-ROM) technology promises to replace the written word of text books with graphics, film clips, and animations.

A key issue one must remember is the success of the present Army school system. In particular, the socialization that occurs at each level of schooling must not be lost in the face of technology. In addition, Army education and training is indeed a system, a university in the

true sense of the word. Any future change must be holistic and preserve a system, not simply tinker with or sub-optimize the pieces of the system.

II. TERMS OF REFERENCE.

The study should, as a minimum:

a. Review technologies used for professional education in the Army, other Services, public and private institutions, academia, and companies.

b. Identify technologies and techniques to enhance education. Recommend uses of these techniques for the Army education system.

c. Delineate the changes in learning strategies that are associated with the use of technology in education.

d. Recommend how the Army can locate and access potentially useful adjunctive technology based materials already in use by industry, academia, and other Services.

e. Identify the barriers and issues of concern which accompany educational technology implementation, and recommend how the Army can overcome them.

f. Recommend the uses of technology for distance learning.

g. In particular, carefully address for the distance learning mode the preservation of socialization, camaraderie, and networking that now are prevalent in conventional course attendance.

h. Insure that appropriate recommendations from the ongoing ASB study, "The Science and Engineering Requirements for Military Officers and Civilian Personnel in the High Tech Army of Today and Tomorrow" are communicated to the Sponsor.

III. STUDY SUPPORT.

Commanding General, US Army TRADOC will sponsor the study. MG Carl Ernst, Deputy Chief of Staff for Training, TRADOC, will be the Cognizant Deputy. Dr. Rebecca A. Campbell, Chief of Faculty Development, Command and General Staff College, will be the Staff Assistant. Major Anne Patenaude, Special Assistant, Office of the Under Secretary of the Army, Operations Research, will be the alternate Staff Assistant.

3

IV. SCHEDULE.

The Study Panel should begin its work immediately. As a first step, the Study Chair should submit a study plan to the Sponsor and to the Executive Secretary, ASB. The Panel should furnish an interim report to the Cognizant Deputy by 1 September 1994 and a final report to the Sponsor by 31 December 1994.

V. SPECIAL PROVISIONS.

The study is not expected to enter into any "particular" matters within the meaning of Section 208, Title 18, of the United States Code.

Sincerely,

Gilbert F. Decker
Assistant Secretary of the Army
(Research, Development and Acquisition)

APPENDIX B

GENERAL FRANKS' REPLY
TO
SUGGESTED CHANGES
TO THE
ORIGINAL TERMS OF REFERENCE

DEPARTMENT OF THE ARMY
HEADQUARTERS UNITED STATES ARMY TRAINING AND DOCTRINE COMMAND
OFFICE OF THE COMMANDING GENERAL
FORT MONROE, VIRGINIA 23651-5000

REPLY TO
ATTENTION OF

July 25, 1994

Allen F. Grum, Ph.D., P.E.
Army Science Board Study Chair
1400 Coleman Avenue
Macon, Georgia 31207-0001

Dear Dr. Grum:

In response to your June 22, 1994, letter, believe your focus on professional education is on target. Officer Basic and Advanced Courses, CAS3, and Command and General Staff Officer Course provide a good study basis on which to recommend technology strategies.

Regret you will not have time to study Noncommissioned Officer Educational System courses; however, your recommendations for technologies should apply to them as well as to West Point and Carlisle Barracks. Suggest a video teleconference with Sergeants Major Academy which is in the process of making a significant investment in technology.

As pointed out during your Fort Monroe visit, majority of TRADOC training resources support basic and advanced individual, aviation, and general skills training. Technology investment must be centered on largest return for the dollar. Would appreciate a recommendation in your final report on need for a Phase II or follow-on study.

Your recommendations may well guide Army training into the future. Cannot overemphasize importance of your work.

TRADOC--Where Tomorrow's Victories Begin!

Sincerely,

Frederick M. Franks, Jr.
General, U.S. Army
Commanding

Copies Furnished:

Mr. Walter W. Hollis, Deputy Under Secretary of the Army
   (Operations Research), 102 Army Pentagon, Room 2E660,
   Washington, D.C. 20310-0102
Dr. Walter B. LaBerge, Chair, Army Science Board, 41 Toulon,
   Laguna Niguel, California 92677

APPENDIX C

ASB PANEL'S LETTER
TO
MR. WALT HOLLIS

MERCER UNIVERSITY

August 29, 1994

Mr. Walter W. Hollis
Deputy Undersecretary of the Army
Operations Research
SAUSOR
Room 2E660
102 Army Pentagon
Washington, DC 20310-0102

Dear Mr. Hollis: *Walt*

We appreciated the opportunity to meet with General Sullivan on 17 August 94. We were impressed with General Sullivan's vision and his obvious interest in our study.

I have inclosed a diagram that attempts to capture some of General Sullivan's remarks. The diagram is faulty as the activities leading to leader behavior are obviously not disjoint. However, we suspect that a Venn diagram with seven activities would be confusing. One of the intents of this exploded pie chart is to suggest that while we will at least consider all of the activities of the pie chart (and the interaction of technology with these activities), our primary focus will be on using technology to enhance education.

In closing, we thank you for your help and support in the study. We see our product as having a potential for significant changes in Army training and education. We feel this responsibility deeply.

Yours truly,

Allen F. Grum, Chair
Army Science Board Study
on Using Technology in Education
and Training

Incl.

AFG/vf

DESIRABLE LEADER BEHAVIOR
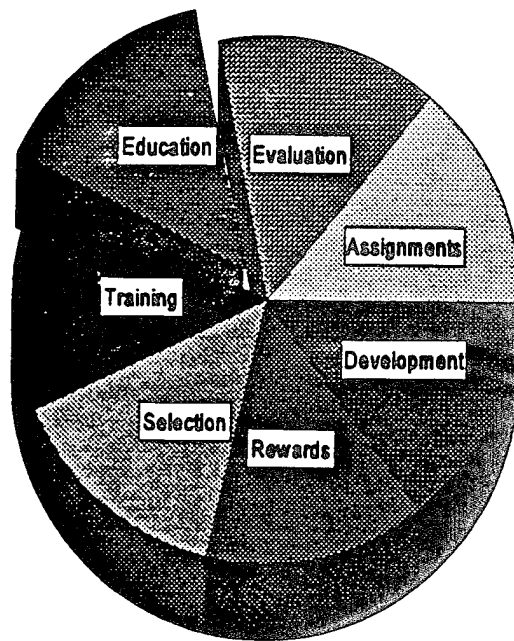
TECHNOLOGY

APPENDIX D

PARTICIPANTS LIST

PARTICIPANTS LIST

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"USE OF TECHNOLOGIES IN EDUCATION AND TRAINING"

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APPENDIX E

THE
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FOR
JOINT NTU-ARMY RESEARCH

NTU ®

National Technological University
700 Centre Avenue
Fort Collins, CO 80526-1842
303-484-0668 (FAX)
303-495-6400

A HIGHER
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Education™

August 18, 1994

Dr. Allen F. Grum
Interim Dean
Mercer University
School of Engineering
1400 Coleman Ave.
Macon, GA 31207-0001

Dear Dr. Grum:

Just a note to follow up on our telephone conversation of today. We believe that now is the time to research the potential benefits of PC based multi-media groupware. Combining the "soon-to-be-widely-available" hardware and software with ready access to Internet will provide a supporting network that we believe could greatly enhance a broadband distance learning system such as the one operated by NTU. Among the tasks that we have identified for testing are the following:

- collaborative learning
- team building
- socialization
- mentoring
- academic advising
- video e-mail
- asynchronous videoconferencing
- simulations

Please let me know if a more detailed research statement would be helpful.

Sincerely,

Lionel V. Baldwin
President

LVB:lg

Arizona State University
Boston University
Colorado State University
Columbia University
Cornell University
The George Washington University
Georgia Institute of Technology
GMI Engineering & Management Inst.
Illinois Institute of Technology
Iowa State University
Kansas State University
Lehigh University

Michigan State University
Michigan Technological University
New Jersey Institute of Technology
New Mexico State University
North Carolina State University
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Oklahoma State University
Old Dominion University
Purdue University
Rensselaer Polytechnic Institute
Southern Methodist University
The University of Alabama

University of Alaska at Fairbanks
The University of Arizona
University of California at Berkeley
University of California, Davis
University of Colorado at Boulder
University of Delaware
University of Florida
University of Idaho
University of Illinois at Urbana-Champaign
University of Kentucky
The University of Maryland College Park

University of Massachusetts at Amherst
The University of Michigan
University of Minnesota
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University of South Carolina
University of Southern California
The University of Tennessee, Knoxville
University of Washington
University of Wisconsin-Madison

APPENDIX F

MEDICAL EDUCATION

October 7, 1994

ARMY SCIENCE BOARD

I. Introduction:

The medical industrial complex now represents over 12% of GDP in the United States. Nearly 500,000 M.D.'s are actively in practice with 60,000 medical students and a similar number of physicians in post-graduate training courses. More importantly, because of the R&D spent on medical research, medical care is in consistent flux as improvements are made. The mechanisms of how these groups receive education are instructive to the army education process as both share many of the same problems:

1. a work force that can not easily be removed from job site for retraining;

2. large geographic distribution;

3. variety of specialized tasks each requiring special educational needs;

4. education is directly tied to performance.

These are some of the major differences:

No central educational system or goals for post-graduate training, the largest group of physicians.

Novel technology is used in multiple applications to enhance medical education. There are three distinct phases of medical education. Each phase has used various novel applications. The three phases: basic medical school curriculum; in-hospital training; and post-graduate continuing medical education, are distinct in their goals and have used different solutions to unique problems.

II. Basic medical school curriculum:

The first phase of medical education is the first two years of medical school. The primary purpose of this education is to teach basic information in such subjects as anatomy, physiology, microbiology, pathology, biochemistry, and psychology. The usual format is not very different from an undergraduate education with lectures and laboratories. Novel technology has been used in three areas: computer aided learning, virtual reality for anatomy teaching; and televised lectures to decentralize medical schools. Computer aided learning is often used to illustrate and reinforce physiologic principles, allowing the rapid completion of physiology experiments that in past times required the use of animals. The advent of color high-resolution monitors with representative pictures has also decreased the use of microscopes to study pathology and microbiology specimens

The second major novel technology is virtual reality in anatomy training. The teaching of anatomy by cadaver dissections has been a "rite of passage" for generations of medical students. Dissection is time consuming, technically difficult, often botched and requires a supply of cadavers that have been preserved in known carcinogenic preservatives. The advent of virtual reality cadavers allows rapid repetitive virtual dissection, eliminates hours of tedious work and presents idealized information at no risk to the health of the medical student.

The third major use of technology is to decentralize medical education. In order to combat the trend for physicians to become specialists, a movement to change the venue of the basic training of medical students from the ivory towers to rural communities has started. The concept is that early exposure to rural and/or nonspecialty practices will encourage students to take that career path. The largest example in the United States is the WAMI program (an acronym for the four sponsoring states involved: WA, AK, MT, ID), which is approximately one-third of the students starting medical school at the University of Washington, who will spend their freshman year at sites in Alaska, Montana, Idaho or rural Washington. The

program, now 25 years old, has been very successful in creating rural based primary-care physicians. The technology required is video-taped lectures or live satellite broadcasting of lectures unavailable by professors on site.

Considering there are over 30,000 first- and second-year medical students, the improvements of technology in their training over the past two decades are limited. The reasons for this are not obvious. Perhaps the lack of research monies to explore novel technologies (the primary mission of most medical schools is to do research not teach), may explain this missed opportunity.

III. Hospital based training:

The second phase of medical education is hospital or clinic based and consists of direct patient experience in a facility with various degrees of supervision. The role technology plays in the hospital is high due to the high technology nature of in-patient medical care. In terms of teaching, the most significant impact of technology is the development of multiple user-friendly computer data bases to facilitate diagnosis, treatment options and drug usage. The medical literature is very large and complex but covers almost every possible clinical situation. Therefore, well organized data bases improve the care of patients. The use of data bases has reduced the influence of major text books that presented dogma. An average physician now has raw data at hand. Computer data bases are nonjudgmental as they just report the author's results and potentially biased conclusions. To recreate dogma, consensus statements on various treatment options have now become vogue. The lesson for the army is clear.

The other use of technology is virtual reality in training of use instruments, such as endoscopes, in surgery. This allows residents to develop eye, hand coordination prior to their first case. This technology has no downside. Virtual reality is starting to be used to train physicians in complex patient management. However, the army is taking the lead in the area. At a recent

medical virtual reality symposium, two of three examples were army funded academic effects including a combat casualty virtual reality model.

IV. Continuing medical education:

Health care, at least to now, is not organized on a national scale in the United States. Each physician, hospital, and university have self-determined continuing medical educational goals. Although, continuing medical education is required for relicensure, the nature and course content are, with a few exceptions, completely at the discretion of the individual physician.

Education is expensive. Prior to discussing continuing medical education, a brief review of economics help explain the current system. The pharmaceutical industry has heavily subsidized medical education as a mechanism to both increase awareness of various conditions and to promote specific pharmaceutical products. The total expenditure may exceed $5,000 per physician or 2.5 billion dollars. Although most of this money is spent without central goals, it allows major experiments in this area. Health care reforms, influenced by managed care, may start the process of centralized goals, with the paradoxical effect of insufficient funding for continuing medical education. If physician choice on pharmaceutical products is limited, the pharmaceutical companies may decrease their expenditures in this area.

The inability to remove physicians from work areas for retraining have led to redistribute teachers both electronically and physically. Commonly, guest lecturers by visiting professors and experts are provided via hospitals to physicians. Sale representatives will wait for hours to demonstrate to physicians fine points of new surgical equipment or deliver the latest in medical papers. This approach has obviously worked to encourage the use of novel expensive technology but has drawbacks. First the cost of transporting experts around the country is expensive, they are usually well reimbursed by a pharmaceutical company. They also tend to speak on what is new and exciting rather than the most cost effective solutions to problems at hand.

The electronic technologies include teleconferencing and on-line access to medical information data bases. Remote video is used when the economics of scale don't support a lecture. Rural areas are often served by such systems. Electronic data bases are commonly used by most physicians; this tool, as described previously, is introduced during their in-hospital training.

V. Major differences between medical and army education:

Most medical education is based on facts whether they are based on science or observational experience. Judgment is taught relative to patient management. To my knowledge no medical school or post-graduate course teaches people management or leadership skills. Basic human resource concepts, such as performance reviews, are never practiced by physicians on nurses as the latter are employed by a hospital not the physician. Physicians are seldom graded on performance and peer review organizations have been successfully attacked by targeted physicians on anti-trust "restraint-of-trade" grounds. Physicians also work in a logistic worry-free environment. There are seldom, if ever, limitations of medications, hospital beds, or high-tech equipment. In fact, most physicians do not know their cost or have any knowledge of their supply.

Army education, on the other hand, is organized, formal and eventually leads successful students to command more complex situations. Army doctrine training is uniform. Army commanders are responsible for all facets of their command, including logistics, personnel (two areas in which physicians are not trained).

VI. Conclusions:

Medical education offers two major technology application lessons for the army. The first is that information data bases are a powerful, easy to use tool to teach in an ongoing fashion. The downside is if the data is not somehow put in context, doctrines may be compromised.

The second lesson is that electronically distributed education is possible. Although this may decrease the "rite of passage" at a school house, it provides an opportunity for soldiers at distant bases to participate in advanced courses. In view of future downsizing and limited personnel, this may be a cost-effective solution to some courses.

APPENDIX G

CGSOC "CLUSTERS"

Leavenworth "Clusters"

This is the results of a quick and obviously inaccurate look at the station of origin of the Class of 1994 at Fort Leavenworth. I have divided the group into some geographic areas that are pretty arbitrary on my part. As an example, students from Fort Benning, Fort Stewart, Fort Gillem, and Fort McPherson are all classified as the "Georgia" cluster.

Baltimore-12

Northern Virginia/D.C.-104

Germany-95

Central Texas-30

Hawaii/Korea-27

Central Colorado-17

Georgia-42

Fort Bragg-44

Fort Huachuca-13

Fort Irwin-18

Fort Knox-13

Fort Leavenworth-65

Coastal Virginia-29

Fort Lewis-11

Alabama-26

Fort Polk-17

West Point-61

There are many "onesies and twosies" scattered all over the world not clustered.

APPENDIX H

AN ANALYSIS
OF THE
BROOKS ACT

DEPARTMENT OF THE ARMY
WATERWAYS EXPERIMENT STATION, CORPS OF ENGINEERS
3909 HALLS FERRY ROAD
VICKSBURG, MISSISSIPPI 39180-6199

REPLY TO
ATTENTION OF

August 23, 1994

Information Technology Laboratory

Allen F. Grum, PhD, PE
Chairman, Industrial & Systems Engineering
Mercer School of Engineering
1400 Coleman Avenue
Macon, Georgia 31207

Dear Dr. Grum,

Thank you for the opportunity to assist in your study, and the confidence reflected in your request. The acquisition of automation/communication technology is closely managed at all levels and, it appears that, as it becomes more pervasive in industry and society, the bureaucracy makes it even more difficult. Enclosure 1 provides an overview of the current level of technology management in the federal government. Since technology management issues involve the IM Office, Contracting, Office of Counsel and Audit, representatives from these offices worked together to prepare the answers.

There is a bias against leasing automation and communications technology (AR 25-1, paragraph 2-8) with some specific exceptions. The spirit of the regulation seems to put the time limit at two years, which may be as long as you need. It also allows leasing if the equipment is "approaching technological obsolescence". In today's technology, micro computers are definitely obsolete two years after they are manufactured. The other issue is, however, that leasing must be the lowest life cycle cost alternative. Today's marketplace reality is that leasing for a relatively long period of time would have a substantially greater life cycle cost than purchase since there is no market or salvage value for micros after 10-12 months.

A service contract that furnishes hardware and maintenance over a defined period, without transferring title to the user, is a lease. This type of contract would be subject to the same restrictions and regulations imposed on the lease of any FIP hardware and software. It appears that the most viable and probably the most economical approach to obtaining the required equipment, would be to enter into a supply contract by issuing a delivery order under one of DOD's Indefinite Delivery/Indefinite Quantity contracts.
These contracts cover the level of technology that you require. Maintenance can usually be obtained as a separate line item under the same delivery order, or you could take the same approach to
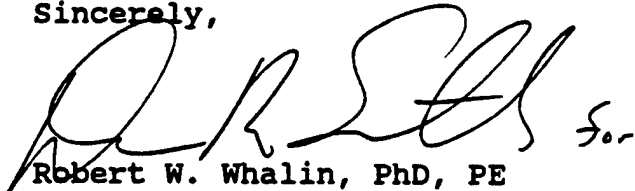
maintenance that we do and not buy it. We have found that stand-
by PC maintenance is expensive compared to the actual need. In
addition, some of the warranties are now written for extended
periods.

Government computers cannot be sold or given to individual
students. However, under the Federal Property Administrative
Services Act, as amended, 40 USC 471 et seq., and its
implementing regulations, such property may be transferred from
one agency and/or command to another. A procedure could possibly
be set up to transfer the particular computer assigned to the
student to his command upon completion of the course.

We will be pleased to provide any additional information that
will assist you in your analysis. Our point of contact at the
Waterways Experiment Station is Mr. H. Murray Huffman at
telephone number 601-634-3661.

Sincerely,

Robert W. Whalin, PhD, PE
Director

Enclosure

Technology Management in the Federal Government
An Overview

In 1965 the Congress gave the GSA sole oversight authority over the acquisition of Information Technology for the Executive Branch of the Federal government in PL 89-306. Two significant things which subsequently happened were: (1) The GSA Regulation known as the Federal Information Resource Management Regulation (FIRMR) which describes the planning, approval, contracting and management of Federal Information Processing (FIP) resources, and (2) the delegation of FIP resource management responsibility through a technology stovepipe vs. command channels. The person in each agency to whom these responsibilities are delegated is known as the Agency's Designated Senior Official (DSO) for Information Resource Management.

The FIRMR instructions are extensive and specific. To give you an idea of the high emphasis on FIP acquisition, it is explicitly stated in the FIRMR that, when there is a conflict between the FAR or DFAR and the FIRMR, the FIRMR takes precedence. The definition of FIP resources as shown in part 201-4.001 of the FIRMR is provided as an attachment to this paper.

The FIRMR goes on to exempt equipment used for intelligence/national security activities (Warner amendment), television, sonar, radar, and radio. Just to make sure there is not even the slightest loophole, however, it makes the point that cellular telephones (technically radio transceivers) are NOT exempt and are covered by the FIRMR. Since almost all technology is covered in the above definitions, it would be reasonable to assume that this would apply only to "significant" dollar value acquisitions. This assumption would, however, be wrong from both the specific language of the FIRMR as well as recent case studies.

The DSO and the people lower in the technology stovepipe who get further delegation have the responsibility to assure that the procedures described in the FIRMR are followed in their respective organizations. These people then give a Delegation of Procurement Authority (DPA) to the Contracting Officer who, in turn, acquires the required FIP. Contracting for FIP without a valid DPA places the Organization's FIP procurement authority as well as the organization's Contracting Warrant and the specific contract(s) in jeopardy.

In addition to these management controls, the GSA, with enthusiastic support from Congress, set up a kind of Technology Supreme Court known as the Board of Contract Appeals (GSBCA) to adjudicate procedural disputes between government agencies and the vendor community. This is a very powerful, very conservative board which will not hesitate to make decisions having devastating impacts on government agencies. As an example, a firm in the greater DC area, C.A.C.I., was given a government

contract for work which delivered a FIP resource. After the work had begun, another vendor protested that the FIRMR procedures had not been properly followed. After a significant period of time (during which C.A.C.I. continued to work), the protest escalated to the GSBCA which ruled that in the absence of a valid Delegation of Procurement Authority (the result of properly followed FIRMR procedures), there is no contract. There were no contractual rights or obligations on the contractor or government side. As you can imagine, this created substantial problems all around.

The purpose of providing this information is to help establish the perspective that, for whatever reason, the Congress has, through public laws and procedures, made it clear that technology is a non-routine government resource and must be managed very closely. There are many of us at the operating level who see this as more restrictive than necessary. In fact, an original component of the National Performance Review was to reform the process of acquiring FIP resources. There was a lot of noise and activity, but when the dust settled, nothing much had changed. It appeared that the Congress told the administration to go sit in the corner on this issue and made it stick. The power behind this has traditionally been the Chairman of the House Committee on Government Operations; previously Jack Brooks, currently Congressman John Conyers. While substantial changes in this area would be welcome, knowledgeable federal officials are not optimistic they will happen.

In defense of the policies and procedures put in place to manage the use of technology in the government, a major underlying objective is to force agency recognition of the technology issues beyond acquisition. Technology, especially with the active support of vendor propaganda, can easily seduce the unwary into thinking, "Just buy a product and all of your problems will be solved". It is easy to forget things like strategic and tactical technology planning, adherence to industry standards, separating "needs" from "wants", looking at total life cycle costs vs. initial acquisition costs, dealing with support issues, assuring immediate and long-term interoperability, etc. The principles coming out of the FIRMR are intended to force the agencies to address all of these issues. Unfortunately, since across the federal government, there is uneven and, at times, even arbitrary application of the FIRMR, more energy may be spent trying to circumvent the rules than addressing these important issues.

While the FIRMR has some room for interpretation, there may not be many remedies to mitigate a conservative approach. Because of the high profile of FIP acquisition, it is probable that the conservative approach will always be supported by higher levels in the organization in question. This is especially true since, in general, the command channels have no direct authority for FIP acquisition.

FIP Resources as Defined in Part 201-4.001 of the FIRMR

"Automatic Data Processing Equipment as defined in PL 99-500 and set out in paragraphs (a) and (b);
     (a) Any equipment or interconnected system or subsystems of equipment that is used in the automatic acquisition, storage, manipulation, management, movement, control, display, switching, interchange, transmission, or reception, of data or information --

     (1) by a Federal Agency, or
     (2) under a contract with the Federal Agency which --
     (i) requires the use of such equipment, or
     (ii) requires the performance of a service or the furnishing of a product which is performed or produced making significant use of such equipment.
     (b) Such term include --
     (1) Computers;
     (2) Ancillary equipment;
     (3) Software, firmware, and similar procedures;
     (4) Services, including support services; and
     (5) Related resources as defined by regulations issued by the Administrator for General Services.
     (c) The term, FIP resources, includes FIP equipment, software, services, support services, maintenance, related supplies, and systems. These terms are limited by paragraphs (a) and (b) of the definition of FIP resources and are defined as follows:
     (d) FIP equipment means any equipment or interconnected system or subsystems of equipment used in the automatic acquisition, storage, manipulation, management, movement, control, display, switching, interchange, transmission, or reception of data or information.
     (e) FIP maintenance means those examination, testing, repair, or part replacement functions performed on FIP equipment or software.
     (f) FIP related supplies means any consumable item designed specifically for use with FIP equipment, software, services, or support services.
     (g) FIP services means any service, other than FIP support services, performed or furnished by using FIP equipment or software.
     (h) FIP software means any software, including firmware, specifically designed to make use of and extend the capabilities of FIP equipment.
     (i) FIP support services means any commercial non-personal services, including FIP maintenance, used in support of FIP equipment, software, or services.
     (j) FIP system means any organized combination of FIP equipment, software, services, support services, or related supplies."

APPENDIX I

GLOSSARY

GLOSSARY

ABA	American Bar Association
ACR	Armored Cavalry Regiment
ACT	Adaptive Control of Thought
AGR	Active Guard and Reserve
ALMC	Army Logistics Management College
ARI	Army Research Institute
ASB	Army Science Board
BAST	Board of Army Science and Technology (National Academy of Sciences)
BRAC	Base Realignment and Closure
CAS^3	Combined Arms and Services Staff School
CBT	Computer-Based Training
CGSOC	Command and General Staff Officer Course
CLE	Continuing Legal Education
COFT	Conduct of Fire Trainer
CSA	Chief of Staff, Army
DIS	Distributive Interactive Simulation
DLI	Defense Language Institute
DoD	Department of Defense
DoDPI	DoD Polygraphic Institute
FM	Field Manual
GED	Graduation Equivalency Diploma
GSA	General Services Administration
HQDA	Headquarters, Department of the Army
IAT	Institute for Academic Technology
ITL	Information Technology Laboratory
IVD	Interactive Video Disk
NCO	Non-Commissioned Officer
NSF	National Science Foundation
NTU	National Technical University
NWC	Naval War College
OSU	Oklahoma State University
POI	Program of Instruction

ROTC	Reserve Officer Training Corps
RIF	Reduction-in-Force
SEN	Satellite Education Network
SIMNET	Simulation Network
TDY	Temporary Duty
TNET	Teletraining Network
TOR	Terms of Reference
TRADOC	Training and Doctrine Command
UMR	University of Missouri at Rolla
USAFA	United States Air Force Academy
WES	Waterways Experiment Station (U.S. Army Engineer)

APPENDIX J

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